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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On a Turn Table Recently Constructed for the Providence, Hartford, and Fishkill Railroad, at Hartford, Connecticut. By A. F. WILDER, Assistant Engineer.—(With a Plate.)

THE tables for turning engines and cars as originally constructed, were of very moderate dimensions compared with those now built, having a diameter just sufficient to take on an engine of the small size then in use, which was uncoupled from the tender and turned separately.

There were several different plans devised in England for these tables, which furnished models for those constructed in this country. The principal reliance for support was a large pivot, of sufficient size to sustain the platform in a level position. This pivot worked in a socket below, with considerable loss of power by friction, as the table was quite unequally balanced, when the drivers and forward truck of the engine were on opposite sides of the centre.

In another form, or capstan table, the point of suspension was at the top of an upright pillar, firmly fixed on the foundation, and about which the table turned. This was simply the former pivot inverted, and when the platform was large enough to take on both engine and tender, it was sometimes supported by struts, attached at their lower extremities to friction rollers, which worked against the pillar.

But in tables of large size, the outer edge is usually supported upon wheels, and the manner of attaching these wheels, constitutes the main difference in different tables.

In the first form, they are fixed by their axles to the foundation, and

have no progressive motion, but tread upon a rail attached to the platform. In the second form they are fixed to the platform, and move with it, running upon a rail laid on the foundation. In this case they can be placed under those points where there is most weight to be sustained, for which reason a smaller number will be required.

In the third form, they tread both upon a fixed rail below, and a movable one above, the axles sustaining no pressure, but serving merely to keep the wheels in position. They are sometimes held in their places by a groove cut in the periphery, running upon rails above and below, of the proper section to fit this groove, the axles being supported by concentric bands of iron, or wood and iron combined, passing around on their outer and inner sides. In tables of moderate size, the axles sometimes extend to the centre, where they are attached to a collar revolving about the pivot. A form of table very common in New England, is constructed upon this principle, having a track circle of small diameter compared with the whole length of platform, which is usually sufficient to admit a large class engine and tender together.

But when this is impracticable in tables of large size, a frame work of wood is constructed, composed of arms extending in all directions from the centre, with which the wheels are in some way connected. This is technically called the spider, and revolves about the pivot in the same direction with the platform.

The grooved wheel is perhaps the simplest of these methods; but the principal objection to its use, is the friction at the place of contact with the rail, which acts with much greater leverage here, than if transferred to the axle, where its resistance is slight. The platform and spider are usually constructed in this country of wood; that being the most economical material.

The engraving represents a table of 42 feet diameter, designed and constructed for the Providence, Hartford, and Fishkill Railroad during the last season.

Fig. 1 shows a plan of foundations—the piling and masonry under the track and centre. The material is a plastic clay or mud, of the Connecticut River Valley, very yielding and slippery when saturated with water. Sixty piles were therefore driven under the track, and nine under the centre, from 25 to 30 feet in length, and $1\frac{1}{4}$ feet apart, in the manner shown in the drawing. These piles were of chestnut, one foot average diameter. The hammer used in driving, (1500 lbs. weight,) was raised by means of a locomotive, worked upon a track near by, to which the fall rope was attached. This was found to be a very economical arrangement in the absence of a pile driving engine, though rather clumsy.

After the piles had been cut off at the proper level, the clay was excavated about them to the depth of two feet, and one foot of coarse gravel filled in, and upon this one foot of concrete, made of broken stone mixed in the usual proportions and compactly rammed, even with the tops of the piles. The foundation stones for the track, (30 in number, 16 inches thick by 2 feet width,) were then laid upon this, well bedded upon the tops of the piles and the surface of the concrete. The common inverted T rail, (60 lbs.,) curved to a radius of 18 feet 10 inches, was then fixed upon this foundation by spikes set in sulphur, for the lower

track. The same rail was also used for the upper track; though a lighter pattern would have been equally serviceable, had it been at hand. The most important requisite in the rail is a small bearing surface, as it is much easier to avoid friction by diminishing this, than by coning the wheels, and without any danger of cutting or wearing; if, as in this table, the weight is thrown principally upon the pivot. The centre block is laid in the same way, and to prevent any lateral motion, is held by two bolts passing through its entire thickness into the piles below.

Fig. 2 shows a plan of the spider, or frame work, which retains the wheels in their places. It is constructed of 18 radial arms, of 4×8 inch timber, bolted at the centre to a casting which revolves around the lower part of the pivot. The frame work about the circumference is constructed of the same number of pieces, of $1\frac{1}{2}$ by 5-inch timber, fitted into the ends of the arms, one above the other, as shown on the plan. This frame work constitutes a truss which gives great stiffness to the spider, and prevents any deviation in position of the wheels.

Fig. 5 shows a section of the wheel through its diameter, in the direction of the axle. It is of cast iron, 150 lbs. weight, and is held in place by two washers and a pin which passes through the diameter of the axle. It is twenty inches high, and three inches thick at the circumference, which is turned perfectly flat without coning. The axle is of wrought iron, $3\frac{1}{2}$ feet in length, and is fastened to the spider by three bolts, two through the arm, and one through the two pieces which meet outside the wheel. Besides fastening the axle, these bolts serve in part to hold together the frame work of the spider. The wheels can easily be taken out at any time, after lifting the table so as to free them, and removing these bolts.

Fig. 4 represents a section of the centre pivot, and casting to which the spider arms are attached. The pivot is constructed in two parts, one of which is fastened to the foundation stone by eight bolts set in sulphur, with thread and nut upon the upper end. The upper part rests against an oak block, which separates it from the eighteen inch supporting timber of the platform, and is held by bolts passing through this timber, as shown in fig. 6. The two parts of the pivot are separated by a cast steel ball of 4 inches diameter, resting in sockets carefully turned and fitted. The spider plate, represented by that part of the drawing which is not shaded, revolves about the lower pivot, which has its surface turned to receive it. The weight of these castings is as follows: upper part of pivot 110 lbs.; lower part or pedestal 168 lbs.; spider plate 361 lbs.

Fig. 3 represents a plan of platform and flooring. The platform is designed for two tracks across the centre at right angles, and is constructed first of a timber 18 feet long, 18 inches square, supported by the centre pivot. At right angles to this are eight cross timbers, supported at their extremities by the track circle, four of which rest upon the 18-inch timber. Above, and at right angles to these, are two main timbers, resting upon, and supported by the eight cross timbers. The four main timbers are trussed, which furnishes a means of throwing the weight upon the centre and relieving the wheels. The flooring is of 3-inch plank, caulked and coated with a composition of pitch and tar.

Fig. 6 shows a section through the centre of table, giving a view of the general arrangement. The upper rail, and rack by which the table is turned, are bolted to a circle composed of timbers 6 inches thick by 12 in. width, which rest at their extremities upon blocks of the proper thickness placed upon the cross timbers.

The scale of figs. 1, 2, 3, and 6, is ten feet to the inch, or $\frac{1}{120}$.

That of figs. 4 and 5, is one foot to the inch, or $\frac{1}{12}$.

The following specifications show the material used in construction. In addition to this, 6000 feet B. M., white pine plank will be required for the furoughing and flooring, together with blocks between floor timbers and track circle, to give it the proper height, and twelve $\frac{1}{2}$-inch blocks between the pieces forming the circumference of spider where they are not in contact at the crossing points, and under the ends of axles. The pieces forming the track circle will be worked to a uniform size of 6×12 inches.

Several small bolts for fastening the upper and lower tracks will also be necessary, and four cast iron saddles for bearings of truss bolts.

Specifications for Hard Pine Timber for Turn Table.

No. of sticks.	Description.	Length in feet.	Size in inches.
18	Arms for spider,	19	4×8
18	Outside frame for spider,	16	1½×5
4	Main timbers of platform,	42	10×12
2	Floor "	40	10×12
2	" "	34½	9×12
2	" "	25	8×12
1	Supporting timber,	18	18×18
4	Furoughing over main cross timber,	18	6×10
2	" "	4½	6×10
2	Main trusses,	10	6×8
4	"	13	6×8
2	Cross "	5½	6×8
4	"	16	6×8
8	Track circle,	5	6×14
4	"	8½	6×18
4	"	6	6×15
4	"	5½	6×14

Bolts for Turn Table.

Number.	Description.	Length in ins.	Size in inches.
2	For centre stone,	36	1¼
6	" Lower pivot,	12	1
36	" Centre of spider,	10	⅞
36	" Axles,	10	⅞
18	" " out end,	6	⅞
12	" Spider frame,	4	⅞
6	"	5	⅞
8	" Pivot and centre block,	30	1
4	" Main truss,	46	1
4	" Cross "	54	1
12	" Main track and floor timbers,	22	⅞
4	" " (through truss,)	25	⅞
4	" supporting and floor timbers,	30	⅞
64	" Track circle,	35	½
16	" "	46	½

HARTFORD, PROVIDENCE AND FISHKILL

RAILROAD.

HARTFORD TURN TABLE.

T. Sinclair's Lith, Philad.a

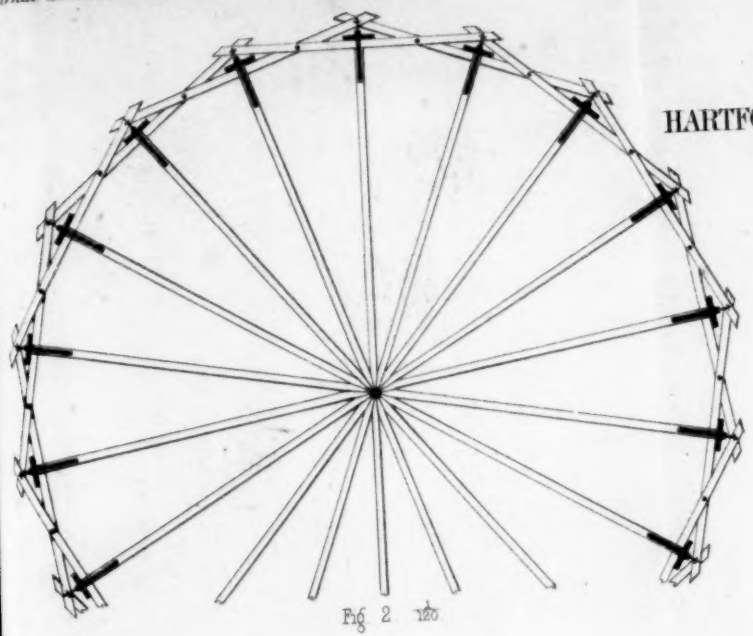

Fig 2 1/120

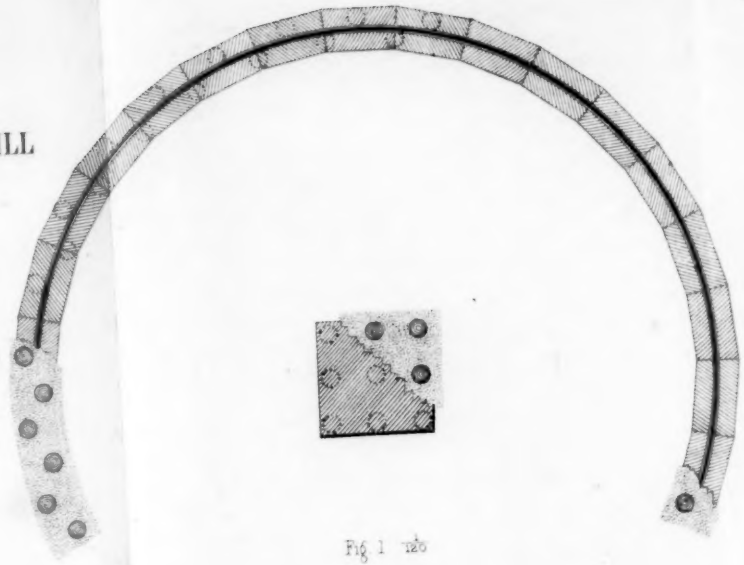

Fig 1 1/120

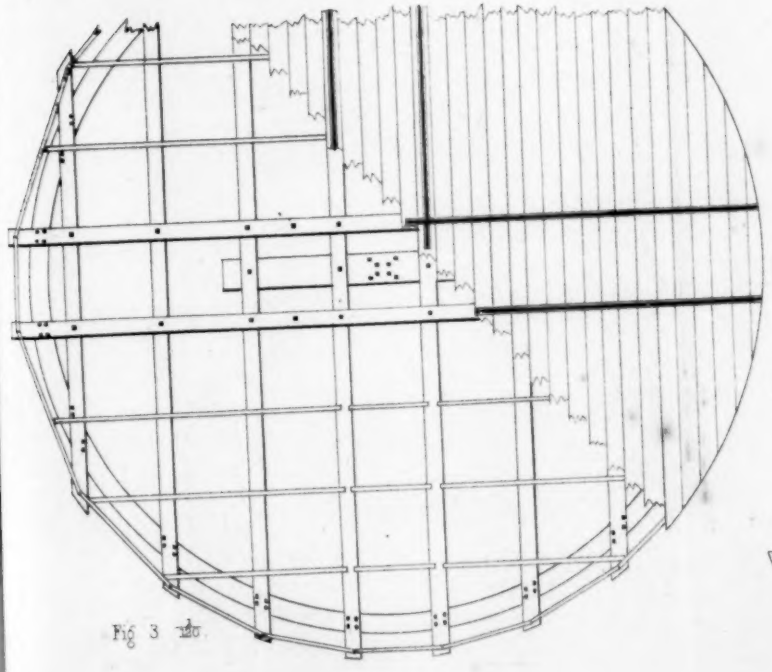

Fig 3 1/120

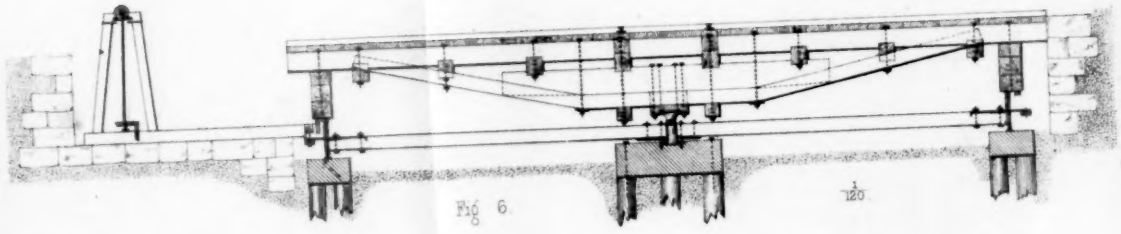

Fig 6 1/120

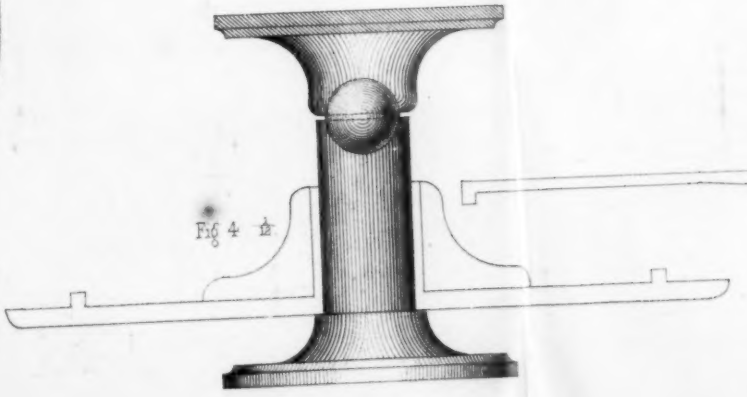

Fig 4 1/12

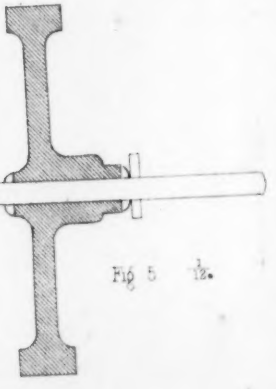

Fig 5 1/12

*Why should there be good Roads on the Continent and bad ones in England?**

The following letter addressed to the *Times*, by Mr. William Howitt, well deserves re-publication at this period of the year:—"About this time of the year a vast quantity of stones, ready broken and heaped up by the roadsides for the purpose, are suddenly poured upon our highways. Whole stretches of the principal thoroughfares all over the country are deluged with these loose stones, some three or four inches in depth, which are left to be ground down or ploughed up, as it may be, by the passing wheels of carriages. If the weather happen to be dry, the nuisance remains for weeks, adding fearfully to the labor of horses, at a season when they are notoriously faint. The intolerable mass is continually stirred and tossed to and fro by the feet of the unhappy horses, and the wheels of all sorts of vehicles, till three-fourths of the 'metal,' as it is called, is ground into dust—in other words, is absolutely wasted, and worse, for the first winter's rain converts it into mud, which has to be scraped off and conveyed away. The stony infliction is continually thrown into heaps and furrows by the passing traffic, and requires, from time to time, leveling with rakes and shovels—an extra expense. Where the whole width of the road is not covered with the new material, every driver of a carriage avoids the abomination as long as he can, and the men employed on the roads resort to the ingenious method of laying huge stones on the smooth side, or stretching trestles across it, to force the reluctant Jehus, and still more reluctant horses, back upon the loose stones.

"Now, it has often occurred to me, in witnessing this barbarous and uneconomical proceeding, whether, among the vast numbers of our countrymen who annually traverse the beautifully kept highways of France, any of the trustees, surveyors, or overseers of our highways ever mingle among them. If they do, is it not extraordinary that they have not for these years past observed the simple and effectual method which our neighbors have of saving their road-metal, their horses, their carriages, and their tempers, by passing a stout roller, drawn by a stout team of horses, over the new material the moment it is laid down? By this method the metal is at once equally pressed down into its place, as soon as it is once laid level, and the roller is passed and repassed over it till it is nearly as solid and as smooth as the old road.

"By this means the metal is saved from that wasteful destruction which it undergoes under our rude and reckless system, and, what is of infinitely more consequence, the horses are spared the inhuman extra tax on their vital energies. How happens it that our societies for the prevention of cruelty to animals have never thought of this? I will venture to say that more needless cruelty is inflicted on our horses, especially in the neighborhood of great cities, by this barbarous and wasteful system, than by all the savage cabmen that these societies call up for their offences throughout the kingdom. Any one who has occasion to pass up Highgate-rise—a hill, in its smoothest state, the name of which is hate-

* From the Practical Mechanics' Journal, Jan., 1858.

ful to the ears of cabmen, coal-carriers, brewers, and the like—may at once convince himself, by observing the violent efforts of loaded teams to get up it, of the truth of this assertion.

"In fact, it is high time that we imitated our French neighbors, who are far ahead of us in this respect, and are really humane to their cattle, while we are only pretending to be so. When the weather is dry, they plentifully water their newly laid roads, so that they may roll solidly and quickly. Some years ago Macadam went abroad, and seeing the infinitely superior state of the roads there, came home and invented the system here called after him. Let some other equally original genius take a look at the roads of France, and invent rollers for highways; and however envious people may be, as they always will, pretend that all that has long been known and practised on the continent, he will still have the real merit of being humane and patriotic, for he will do more for the prevention of suffering to horses and the abatement of highway rates, than has been done by any number of men these twenty years.

"I have lately observed with pleasure that rollers have been applied to the side paths when new graveled:—one more move in advance. Apply them to the main road, and we shall escape from the opprobrium of lagging so far behind our ingenious allies across the Channel."

Every one must feel the sound force of what Mr. Howitt says, and wonder how, when the remedy is so completely within our reach, we do not put ourselves in a better position as regards our means of internal communication. In our own articles, "Work for Inventors,"* and "Our Unwillingness to Adopt Obvious Improvements,"† we have already endeavored to arouse public attention to this very point, and have shown —as Mr. Howitt now explains—how the French road makers at once level their newly applied broken stone, and thus accomplish mechanically, and in a most effective way, what in this country is only done very ineffectively by the actual traffic over the roads. The French make the roads complete and ready for the traffic—we make the traffic, at infinite pains and cost, reform the roads.

We are now just re-entering, as it were, upon the British end of loose stony roads, and the time is therefore propitious for the discussion of the question. All our thoroughfares, and particularly those leading out of towns, are fast being visited with their annual plague of loose "metal." This visitation is of the most abominable kind, and humiliating in the last degree to our character as a common sense mechanical nation. It has often been said, "The Sabbath was made for man, and not man for the Sabbath;" and certainly the same view may be taken as to our roads, for if ever anything was made for another, the roads were made for the traffic, and not the traffic for the roads. As we now go on, we undeniably lose the great end in the consideration and working of means; therefore we repeat, "Why should there be good roads on the Continent and bad ones in England?"

In attempting a reply to Mr. Howitt, Mr. Macadam—a grandson of the great road maker—tries to show that rolling will not do; but he does not explain how Paris comes by her splendid roads, whilst we are injur-

* *Practical Mechanic's Journal*, page 241, vol. 8.

† *Practical Mechanic's Journal*, page 225, vol. 1, second series.

ing ourselves, our horses, and our carriages, with bad ones. But he lets out an important fact when he speaks of "the great aptitude of the French to adopt that which is proved to be useful." This is the secret; and no one can plant his foot on French soil without having his eyes fully opened to this "great aptitude,"—a possession which, in this instance, appears to make all the difference between good and bad roads. Good roads, as Mr. Macadam frankly admits, can be made—then why can we not have them?

Since the appearance of Mr. Howitt's remonstrance, "a Yorkshireman" has written on the subject as follows:—"The cruel practice of leaving wheeled carriages to do the work of rollers is not in vogue in Yorkshire. There, as in France, the road is prepared by 'roughing,' preparatory to spreading the 'metal.' Over the 'metal' a slight sprinkling of road scrapings is thrown to make it set, and then a heavy roller. I should observe that this is generally done in wet weather, but if it is found requisite to repair in dry weather, a liberal use of the water-cart is considered necessary previous to rolling. To leave out of question the great cruelty to the horses, I really believe that it would pay the London Omnibus Company alone to roll every road on which their traffic lies." We are glad to find that there is one spot in England where scientific road-making is understood; and more than this, that we can now point to successful practice as an answer to the retarders of improvement, who strive to keep things as they are.

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*Tubular Bridge for the Straits of Dover.**

As an opposition scheme to the old notion of a submarine tunnel beneath the Dover Straits, Mr. Boyd, of Barnes, Surrey, now treats us to a tubular railway bridge for connecting the two countries. The proposed bridge, or viaduct, is designed for the purpose of uniting the railways of Britain with those of Continental Europe generally. The English terminus of the bridge will rest on Dover Cliffs, to give the necessary altitude above the level of the sea for the free passage of vessels of the largest dimensions, and the bridge will be supported across the Straits by towers rising from the bed of the Channel, at equal distances apart,—say of about 500 feet; the summit of each tower will form a light-house, and contain a gas reflector and an alarm, for the double object of guiding ships by night, and of warning them of danger in time of fog; the gas to be lighted at sunset throughout the whole line of viaduct, and the alarm to be set in action when necessary—in either case by electric apparatus, at the will of the superintendent at either terminus. The towers at water-mark will be fitted with "fenders," to prevent accident to shipping in the event of any unforeseen collision, and the French terminus of the bridge will rest on Cape Grisnez, the land approach to which will require to be brought to the same elevation or level as the English terminus. The viaduct will be about twenty miles in length, and could be traversed by trains in twenty minutes at all seasons of the year. The

* From the Practical Mechanic's Journal, Jan. 1858.

greatest depth of the Straits is about twenty-one fathoms, and the ordinary depths from twelve to fourteen fathoms, with a chalk foundation; and although the proposed bridge is of tubular formation, it would be constructed so that the light of day may illuminate it in daytime, and a free current of fresh air pervade it at all times. The batteries of Dover Castle would command the English approaches, while a battery could be placed to cover the French terminus, and thus secure either country from the apprehension of invasion. It is now too late in the day of our age to discuss the question of possibilities; but has Mr. Boyd, or any one else, ever sat down to count the cost of a scheme like this?

On an Element of Strength in Beams subjected to Transverse Strain, named by the author "*The Resistance of Flexure.*"* By Wm. Henry Barlow, Esq., F.R.S.

In his former paper (see *Journ. Frank. Inst.*, vol. xxxii., p. 4,) on this subject, the author pointed out the existence of an element of strength in beams when subjected to transverse strain,—the resistance of flexure—which had been omitted in the generally received theory; and the object of the present experimental inquiry is to elucidate more clearly the general bearing of the subject, and determine more precisely the laws which govern this resistance.

The forms of beam employed in the experiments formerly described were only of two kinds—solid rectangular bars and open girders; in the present experiments other forms have been used, namely, square bars broken on their sides, square bars broken on their angles, round bars, beams of the I section broken with the flanches horizontal, and similar beams broken with the flanches vertical ⊢.

The results of these experiments are exhibited in tables, together with those of the former series; and the author employs them, in the first place, to test the accuracy of the existing theory, by comparing the resistance of the outer fibres or particles of each of the forms of beam, calculated on that theory, with the actual tensile strength of the metal as obtained by direct experiment. From this comparison applied to the different forms of beam, it would follow that the resistance at the outer fibre varies from 25,271 lbs. to 53,966 lbs., while the tensile strength of the metal, obtained by experiments on direct tension, averages only 18,750 lbs.; and the discrepancy and variation will be found to arise from the received theory not taking into account the resistance consequent on the molecular disturbance accompanying curvature.

In his former paper the author gave a formula by which the difference between the tensile strength and the apparent resistance at the outer fibre could be computed, approximately, in solid rectangular beams and open girders; and he now proposes to trace the operation of the resistance of flexure, considered as a separate element of strength, and to show its effect, in each of the forms of section above indicated. Observing that the usual supposition of only two resistances in a beam, tension and com-

* From the Lond., Edin., and Dub. Philos. Mag., Dec., 1857.

pression, fails to account either for the strength, or for the visible changes of figure which take place under transverse strain, he proceeds to discuss the effects involved in such change of figure, and thence arrives at the following conclusions applicable to the resistance of flexure :—

1. That it is a resistance acting in addition to the direct extension and to compression.

2. That it is evenly distributed over the surface, and consequently (within the limits of its operation) its points of action will be at the centres of gravity of the half-section.

3. That this uniform resistance is due to the lateral cohesion of the adjacent surfaces of the fibres or particles, and to the elastic reaction which thus ensues between the portions of a beam unequally strained.

4. That it is proportional to, and varies with, the inequality of strain, as between the fibres or particles nearest the neutral axis and those most remote.

Formulæ are then given, according to these principles, exhibiting the relation between the straining and resisting forces in the several forms of section experimented on, as resulting from the joint effect of the resistances of tension, compression, and flexure. The application of these formulæ to the actual experiments yields a series of equations with numerical co-efficients, in which, were the metal of uniform strength, the tensile strength, the tensile strength f, and the resistance of flexure ϕ, would be constant quantities, and their value might be obtained from any two of the equations; but as the strength varies even in castings of the same dimensions, and as a reduction of strength per unit of section takes place when the thickness is increased, the values of f and ϕ will necessarily vary, and can only be ascertained in each experiment by first establishing the ratio they bear to each other. For this purpose the first ten experiments are used, in all of which the metal was from $\frac{3}{4}$ to 1 inch in thickness, and its mean tensile strength ascertained by direct experiment to be 18,750 lbs. per inch. The resulting mean value of ϕ is = 16,573 lbs., and the ratio of f to ϕ as 1 to ·847.

By using results obtained by Prof. Hodgkinson on the breaking weight of inch bars of ten different descriptions of iron, where the tensile strength was ascertained by direct experiment, it would appear that the ratio between the resistance of tension and the resistance of flexure varies in different qualities of metal, an inference which seems to be confirmed by other experiments on rectangular bars given in the Report of the Commissioners on the application of iron to railway structures. The mean result, however, accords nearly with that of the author's experiments, and gives the ratio of f to ϕ as 1 to ·853. Hence, according to these data, the resistance to flexure, computed as a force evenly distributed over the section, is almost nine-tenths of the tensile resistance.

This ratio of the values of f and ϕ being applied to the equations resulting from the several experiments, gives the tensile strength of the metal as derived from each form of section, and the results, though not perfectly regular, are found to be within the limits of the variation exhibited by the metal as shown by the experiments on direct tension in

the former paper. Classified and condensed, these results are as follows:—

The mean tensile strength as obtained from

The open girders, is	18,282
The solid rectangular bar of 2 inches sectional area, .	17,971
The inch bars—square and round, and square broken diagonally,	19,616
The bars of 4 inches sectional area, square and round, and square broken diagonally, ...	16,800
The compound sections in which the metal was ½-inch thick,	19,701

Having thus found that his formulæ, when applied to his own experiments, gave consistent and satisfactory results, the author next tested them by other known experiments, and especially refers to those by Major Wade on the transverse strength of square and round bars of cast iron of different qualities, related in the "Reports on the Strength and other Properties of Metals for Cannon," presented to the United States Government by the Officers of the Ordnance Department. The unit of strength, as computed by Major Wade from these experiments, came out uniformly much higher in the round than in the square bars of the same kind of iron, whence he was led to doubt the correctness of the formula employed; but the author shows that when his formula is used, which includes the resistance of flexure, the discrepancy referred to disappears, and the tensile resistance, whether obtained for the round or the square bars, agrees very nearly with that derived from the experiments on direct tension under like circumstances.

As to the ratio between the resistance of flexure and the tensile resistance, it is remarked that, were the metal homogeneous, the former resistance would probably be precisely equal to the latter, instead of bearing the ratio of nine-tenths, as found by experiment; but the ratio evidently varies in different qualities of metal; and accordingly from Major Wade's experiments, it appears that with the same metal subjected to different modes of casting, an increase of transverse strength may accompany a decrease in the tensile resistance.

Respecting the limit of action of the resistance of flexure, the author observes, that in all the simple solid sections, the points of action are evidently the centres of gravity of the half-section; while in the compound sections it is necessary to compute the centre rib and flanches as for two separate beams in which the resistance of flexure is different, and has its point of action at the centre of gravity of the separate portions. It would appear that the elastic reaction develops this resistance to the full extent when the section is such that a straight line may be drawn from every point at the outer portion to every point at the neutral axis within the section; but that if the form of section is such that straight lines drawn from the outer fibres or particles to the neutral axis fall without the section, then it must be treated as two separate beams, each having that amount of resistance of flexure due to the depth of the metal contained in it.

The last section of the paper is devoted to the consideration of the resistance of flexure in wrought iron; and experiments are first given to determine the position of the neutral axis, from which it is found to be at the centre of gravity of the section, as in cast iron; so that the action

is the same in both materials, except as to the amount of the extensions and compressions with a given strain; and the formula given for cast iron will also apply to wrought iron. As wrought iron yields by bending and not by fracture, the relative value of f and ϕ are not so easily ascertained; moreover, the ultimate compressive strain which wrought iron can sustain is little more than half its ultimate tensile strength; nevertheless the force required to overcome the elasticity of the material is nearly the same, whether applied as a compressive or tensile strain; the difference being, that the force which overcomes elasticity when applied as a compressive strain leads to the destruction or distortion of the material, while, in the case of the tensile strain, the elasticity may be overcome long before the material yields by absolute rupture.

A statement is given of the results of experiments made by Prof. Barlow, in 1837, to show the weights which overcome the elasticity of the metal when applied transversely as compared with the weight necessary to produce the same result when applied by direct tension, and from these it is concluded that the resistance of flexure in wrought iron, considered as a force acting evenly over the surface, is nearly equal to one-half of the tensile resistance.

In an Appendix to this paper, by Professor Barlow, the preceding principles are applied to beams and rafters of non-symmetrical section.

With this view, the case of the double-flanched girder with unequal flanches is selected and discussed, and formulæ deduced, which are then tested by comparison with the results of experiments by Prof. Hodgkinson, published in the "Manchester Memoirs;" a selection being made of those in which the girders differed most from each other in section, dimensions, and bearing-distance. The chief particulars of these experiments are given, with diagrams showing the forms of sections, and the values as obtained from the formulæ are stated. The value of the direct tensile strength of cast iron thus derived, falls between the limits of 1400 and 1700.

In the Reports of the Commissioners of Inquiry into the "Application of Iron to Railway Structures," are given the results of about fifty experiments on the direct tensile resistance of one-inch square cast iron bars, under the direction of Prof. Hodgkinson. The bars consisted of seventeen different kinds of iron, each set of bars being of the like quality and manufacture: and in several of these sets, which might have been expected to yield the same results, the difference is fully as great as in the cases here exhibited. From this fact an inference may be drawn in favor of the general applicability of the principles developed in the foregoing pages to cast iron beams and girders of every variety of section.

Fluted Propeller.

In a number of "*La Presse*," *M. Figuier* explains the principles which guided *M. Vergne*, a lieutenant in the Navy, in the construction of his fluted propeller, and gives an account of the results of the first experiments on the new propeller in the *Vigilant*, of 60 horse-power.

In the rotation of an ordinary propeller, the water is not only driven astern, but acquires a rotary movement around the axis of the propeller, from which, by its centrifugal force, it also tends to fly off. As this rotary velocity is less than that of the propeller, the blades continually overtake and strike upon these sheets of water, whence the tremulous motion so inconvenient in light boats, and so injurious to the machinery. It is, moreover, evident that the rotary motion thus communicated to the liquid is an useless expenditure of power, and materially diminishes the useful work of the engine. To remedy this defect M. Vergne applies to the surface of the propeller a number of perpendicular ribs at equal intervals. These ribs are in the direction of the intersection with the blades of a cylinder having the same axis. The mass of water in contact with the propeller is thus divided into a number of helicoidal filaments, which are prevented from rotating, and compelled to move directly astern.

For the purpose of trying the new system, a second propeller was cast in the same mould as that of the *Vigilant*, and provided with 20 ribs, 40 millimetres (1·58 inches) apart, and projecting 20 mills. (0·79 inches). The Committee of Examination at Toulon, began, by making four trips with its ordinary propeller over a measured line, and determined a mean velocity of 7·188 knots. Some days afterwards, and under similar conditions of draft of water, wind, and sea, they made four more trips over the same line with the fluted propeller, and found a velocity of 7·942 knots, which gives 0·7 knots in favor of the new propeller. The Committee found that the disturbance of the water around the stern-post had disappeared. The wake was smooth as in a sailing vessel, and the whirlpools only appeared some 7 or 8 metres astern. This fact confirms the theory of M. Vergne, and agrees with the increase of velocity which his theory announces; the tremulous motion was moreover scarcely sensible. The Committee thus concludes its report, "The mean useful result calculated for the ordinary propeller is 0·099, for the Vergne propeller 0·116; whence results an advantage of 17 per cent. for the latter. The means of the velocities were, for the ordinary propeller, 3·697 metres (12·13 feet) per second; and for the Vergne, 4·085 metres (13·4 feet) per second—an advantage of 1·27 feet per second for the latter."

In consequence of these remarkable results, the Committee recommend that more decisive experiments should be made on a larger vessel, and one whose engine will allow of greater precision in the determination of the power developed.—*Cosmos, January 15th*, 1858.

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*Bridges in Australia: a Patent.**

Mr. George Bate, a practical engineer, now living at Yarraberg, East Richmond, in Australia, formerly a resident of Wolverhampton, according to the local *Chronicle*, had constructed a timber bridge, on a new principle, over the Murray River at Echuca. The peculiarities and advantages of the principle (which Mr. Bate has since patented), consist in an arch built after the manner of the felloes of a wheel, a cohesion

* From the London Builder, No. 785.

beam above, and a tension beam below, crossed by radii springing from a common centre, the whole so knit together that external abutments are rendered unnecessary, added to which are cheapness and rapidity of construction, lightness and convenience of transport. The bridge across the Murray is erected on pontoons, and consists of ten arches 33 feet long, 27 feet span, and 10 feet wide. A similar bridge was then designed to cross the Campaspe river, and after being submitted to a committee of inquiry, on which were several eminent engineers, it obtained the sanction of the Colonial Legislature, who passed an Act authorizing the construction of the bridge. The quantity of timber used in this latter bridge is 1200 cubic feet, and of iron three tons. The entire length of the bridge is 121 feet; width, 11 feet clear, and 17 over all; height of sides, 10 feet; span, 107 feet. The net cost was between £700 and £800.

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*On the Mechanical Effect of Combining Girders and Suspension Chains; and a Comparison of the Weight of Metal in ordinary and Suspension Girders to produce Equal Deflections with a Given Load.** By PETER W. BARLOW, Esq., C. E., F. R. S., F. G. S.

[Read before Section G of British Association.]

My attention has been recently directed to this subject from having been required to investigate, as engineer of the Londonderry and Enniskillen and Londonderry and Coleraine Railways, the best mode of effecting a junction between the lines at Londonderry, to be combined with an improved road communication, for which an Act has been obtained by the Corporation of the city, and the commissioners having determined to advertise for plans, leaving the decision to Sir William Cubitt —an engineer justly occupying a position so eminent, and in whose judgment I had the greatest confidence—I determined to submit the result of my investigation, although the principle which I concluded would best meet all the circumstances of the case, viz: the suspension girder, was one with reference to which considerable prejudice had existed.

Sir William Cubitt, after devoting much attention to the subject, has fully sanctioned the principle, and recommended the Bridge Commissioners to carry out my design, with some modifications suggested by him; but as some doubts have been expressed as to the accuracy of my calculations of the weight of girder to make a suspension bridge as rigid as a girder, they decided to refer the question to a second eminent engineer, and the subject is now under the consideration of Mr. Hawkshaw.

In order to verify my calculations, I have caused a series of experiments to be made, the results of which are of so much practical importance, and so fully confirm my investigations, that I determined to lay them before the British Association, in order that the simple question of the mechanical effect of combining a girder with a suspension chain—on which no difference of opinion ought to exist—should be fully decided; but before describing these experiments, I will make a few gene-

* From the London Artizan, Nov., 1857.

ral remarks upon the systems which have been adopted in bridge constructions.

General Remarks upon the Construction of Bridges of Large Span.—Bridges may be divided into three classes—

1st, The arch, a structure in which the supporting material is subjected to compression alone, but which contains no rigidity in itself.

2d, The suspension bridge, in which the supporting material is subjected to extension alone, which also contains no rigidity in itself.

3d, The girder, in which the supporting material is subjected to both extension and compression, of which there are two varieties, one which is subjected to diagonal strains, as the lattice, Warren, and tubular girders; and a second, in which all the strains are confined to the upper and lower webs, as in the bow and string, and Mr. Brunel's new girder, which is a combination of an arch and a suspension chain, each doing half the supporting duty.

This second variety is the most simple form, but has no more rigidity in itself than an ordinary arch or suspension bridge.

Of these three systems the girder necessarily requires from combining compressive and extensive resistances, a much larger amount of metal than either of the other systems, which will be rendered evident by a simple investigation, and by reference to existing structures.

In an ordinary arch the compressive force is resisted by the abutments, which in no way add weight or strain to the metal; but if the arch is converted into a girder, it can only be done by adding a tie-bar, the arch having then to support its own tie, or substitute for an abutment, in addition to its own weight.

In a suspension bridge the extensive force is resisted by back chains; and if these are taken away to make it a girder, a compression-tube or bar has to be used as a substitute for them (as in the Chepstow Bridge), which tube becomes in large spans, with its supports, by far the largest portion of the structure, and destroys the bridge by its own weight; in fact, the weight of metal is thus doubled to produce equal strength, and quadrupled to produce equal rigidity.

The great difference in weight produced by this and other causes, will be seen by comparing suspension girder bridges with ordinary girder bridges; and I will take as an example the case of the two largest railway openings yet constructed, the Niagara Suspension Girder Bridge, and compare its weight of metal with that of the Britannia tube.

The quantity of material in the Niagara Bridge, having a roadway and a single railway of three gauges in a span of 820 feet, is, in round numbers, 1000 tons; and the weight in the Britannia tube of 460 feet span, 3000 tons for a double line.

If the Britannia tube had been made on the same principle as the Niagara Bridge, the quantity of material to give the same strength and rigidity would not have exceeded $\frac{1}{8}$th part of what has actually been employed.

So great a difference in the weight renders it obvious that the principle of an ordinary girder involves great extra material, and it became an interesting and important inquiry to ascertain the cause of this difference.

The view that has hitherto been generally adopted on the subject, is that advanced by Mr. E. Clark, in his work on the "Britannia Tube," in which he states, speaking of the proposal to use the Menai Suspension Bridge for railway purposes, "With respect to the use of the present suspension bridge for the proposed traffic, it was found difficult to devise any means of sufficiently strengthening it that did not involve an almost entire reconstruction; and great difficulty was similarly found in attempting to render any suspension bridge sufficiently rigid for railway traffic by means of ordinary trussing."

"When the passing load is small compared to the weight of the chains, and of the structure itself, there is indeed no difficulty; but the construction of a platform 450 ft. long, sufficiently rigid for railway traffic, almost amounts to the construction of the tube itself."

Although unsupported by facts or experiment, this theory has been received and acted upon, not only by a large portion of the public, whose impressions of suspension bridges are derived from what had hitherto been constructed of insufficient strength, and without being combined with a girder, but it has been received and acted upon by engineers of eminence in this country.

These experiments, however, distinctly prove that a suspended girder, as designed for the Londonderry Bridge, is rendered equally rigid with less than $\frac{1}{25}$th of the metal required in the girder alone; so that the most important economy arises from the combination of a girder with a chain.

Experiments on Suspension Girders.—I have had the model accurately made, which is now submitted to the meeting, on a scale of $\frac{1}{32}$d part of the actual span, the length being 13 ft. 6 ins. between the bearings, a length exceeding that of the average of the models used by the Iron Commissioners in their experiments, and is amply sufficient, due allowance being made for the scale, to determine with accuracy the deflections on the actual girder, although the deflections of the chain will be somewhat more on the model than on the girder, from the weight not being sufficient to bring the surfaces into perfect contact.

The principal object of the experiment was to ascertain the greatest deflection of the wave of a girder attached to a chain, as compared with the deflection of the same girder detached.

This being obtained, it was perfectly easy to arrive at the deflection of the wave of the Londonderry Bridge, because we have sufficient experiments on girders to enable a calculation to be made of what the Londonderry girder would deflect without the chain, which being obtained, and reduced in the ratio of the girder attached to the girder detached, gave the true deflection.

My first intention was to make the experiments with a girder which was a correct model of the actual bridge, which would have indicated $\frac{1}{32}$d of the actual deflection, but I found the deflection of the wave to be so small that it was difficult to measure it with sufficient accuracy, and I therefore had a wooden box made of the correct depth, with the sides as thin as it would stand, viz: $\frac{1}{4}$-inch deal plank, in order to obtain greater deflection of the wave with the correct depth of the girder, and with the chain attached to it, as in the proposed bridge.

I could no longer obtain the actual deflection of the Londonderry bridge by multiplying the experimental deflections by 33, but knowing that the deflection of a model on the correct scale would be $_3{}^1{}_3$d of the Londonderry girder, and knowing by experiment what the model did deflect when unattached, the actual deflection of the Londonderry girder is obtained by reducing the observed experimental deflection in the ratio of the rigidity of the actual model to a true model, and then multiplying by 33.

The deflections of this girder, taken without the chains attached, with a weight of 168 lbs. on the centre, was ·75 of an inch; with the chain attached, and with the weight placed ¼ from the high tower—

lbs.	Deflection at ¼ from high tower.	Deflection at centre.	Deflection at ¼ from low tower.
56	·030	·010	·010
112	·060	·040	·010
168	·075	·040	·010
	Experiment 2.		
56	·030	·020	·000
112	·050	·040	·005
168	·075	·050	·005

The ratio of the deflection of the wave at quarter the distance where the greatest amount arises when the chain is attached to that in the middle when not attached, is as 1 to 10 only; but it was evident, from the large deflection at the centre, and from no rise occurring at the opposite end, that the girder was too rigid to indicate the wave, and that the deflection observed was greatly due to the chain not coming to its bearing.

I therefore decided, in order to magnify the wave, and make its amount more distinct, to have a girder made of angle iron ⅛th of an inch thick, and a quarter the depth of the former girder, but simply suspended from, and not attached to the chain.

The deflection of this girder without the chains, with a load of 42 lbs. placed on the centre, was 1·2 ins.

The deflection of the wave with the chain attached, and 227 lbs. distributed over the girder, when the weights were placed at ¼ from the high tower—

lbs.	Deflection at ¼ from high tower.	Deflection at centre.	Deflection at ¼ from low tower.
56	—·10	—·01	+·05
112	—·20	—·04	+·12
168	—·28	—·06	+·16

Experiment 2.—In this case the weights were placed ¼ from the low tower.

56	+·06	—·01	—·12
112	+·15	—·05	—·25
168	+·18	—·07	—·36

giving an average of 0·32 in. with 168 lbs., equal to ·08 in. with 42 lbs., or $_1{}^1{}_5$th the deflection the girder without the chain.

The deflection of the Londonderry girder, deduced from the mean results of the deflections of the Boyne Viaduct and Newark Bridge and the Britannia Tube (see Appendix A), was 33 ins. with 100 tons in the centre, $\frac{3}{1}\frac{3}{5} = 2{\cdot}20$ ins., the deflection here indicated in the Londonderry Bridge, with 100 tons placed at a quarter the length of the girder.

To obtain the comparative rigidity of the experimental model with a true model of the Londonderry girder, we have 42 lbs. producing in the experimental girder 1·2 inches deflection; a true model would deflect $\frac{33}{33^3}$, or 1·00 in. with $\frac{100}{33^2}$ tons, or 206 lbs. We have, therefore, as 206 : 42 :: 100 : 0·204, the deflection of a true model with 42 lbs., $\frac{1{\cdot}2}{0{\cdot}204}$, or 5·88 times the rigidity of the experimental model, $\frac{0{\cdot}32}{5{\cdot}88} \times 33 = 1{\cdot}80$ ins., the deflection indicated by a weight on the bridge of 168 lbs. $\times$ 33^2, or 81·7 tons, or 2·20 ins. with 100 tons, thus confirming the previous calculation.

It was still obvious, from the deflection at the centre and little rise exhibited in the wave, that the stretching of the chains to bring the metal surfaces to bear, still sensibly influenced the result; and I had another wooden girder made, consisting of a plank 7½ ins. in width and ¾-inch thick, in order to still more magnify the wave, and to diminish the error from the stretching of the chain.

The deflection without the chain attached was 1·48 ins. with 10 lbs.

Experiments with the Chain attached.—With 56 lbs. placed at ¼ from the high tower on the girder, which was previously quite unloaded, the deflections were, at

1·8 from high tower.	¼ from high tower.	3·8 from high tower.	½ from high tower.	5·8 from high tower.	¾ from high tower.	7·8 from high tower.
—·31	—·48	—·32	—·02	+·22	+·29	+·15

Experiment 2.—70 lbs. equally distributed, and 56 lbs. at ¼ from high tower.

—·28	—·42	—·25	+·04	+·23	+·28	+·20

Experiment 3.—150 lbs. all over, weight in same place.

—·20	—·35	—·20	+·02	+·20	+·23	+·14

Experiment 4.—193 lbs. equally distributed; 56 lbs. as before.

—·18	—·31	—·17	+·05	+·18	+·20	+·14

The deflection here indicated, with the model loaded with a weight representing 96 tons on the bridge (which experiment was several times repeated), was 0·31 with 56 lbs., = ·055 with 10 lbs., or 1·26 of the deflection of the girder without the chain. $\frac{33}{26} = 1{\cdot}27$ is, therefore, the deflection of the wave indicated by the experiment of the Londonderry Bridge with a load of 100 tons at ¼ from the tower.

To obtain the comparative rigidity of the experimental girder, we have here as 206 lbs. : 10 lbs. :: 1·00 in. : ·0485, the deflection of a true model with 10 lbs. $\frac{1{\cdot}48}{{\cdot}0485}$, or $\frac{1}{30{\cdot}5}$ represents the rigidity of the experimental girder, $\frac{{\cdot}31}{30{\cdot}5} \times 33 = {\cdot}335$ the deflection by a weight on the bridge of $56 \times 33^2 = 27$ tons. 27 : 100 : : ·335 : 1·27, the deflection, as previously calculated.

This result being so much at variance with the general view of the subject, although very nearly in accordance with my calculations, I determined to verify it by a smaller girder, 6 ins. by $\frac{3}{4}$ thick, which would render the wave still more visible, the observations being made with great nicety.

The deflection at the centre when not attached to the chain was 2·375 ins. with 8 lbs.

Girder attached to the chains.

193 lbs. equally distributed.

Weights placed $\frac{1}{4}$ from high tower.

lbs.	$\frac{1}{4}$ from high tower.	Centre.	$\frac{1}{4}$ from low tower.
56	—·64	+·13	+·53

Experiment 2.—With 56 pounds at the centre of the bridge, the deflection was —·30.

The deflection of the wave here exhibited at $\frac{1}{4}$ of the length, with the bridge loaded to a weight equivalent to 100 tons on the actual bridge (which experiment was repeated several times with the same result), was 0·64 in. with 56 lbs., the deflection without the chains being 2·375 with 8 lbs., or 25 times the amount.

In determining how far this result was effected by the resistance produced by the change in the figure of the curve of the chain, I removed all the weights from the plank, and found the result as follows, with 56 lbs. at $\frac{1}{4}$ from the high tower:—

$\frac{1}{4}$ from high tower.	Centre.	$\frac{1}{4}$ from low tower.
—·85	+·20	+·75

With 56 lbs. placed $\frac{1}{4}$ from the low tower:—

+·81	+·12	—·86

From this experiment it appears that the deflection is decreased by loading the bridge to $\frac{1}{20}$th of that of the girder unattached, and if the chain were without weight it would be still further reduced. In practice, however, the weight on the bridge will much exceed that on a model, and $\frac{1}{25}$th will be the least amount that will arise in practice; a result so at variance with the preconceived notions of many engineers, that it is to be expected, in some instances, it will be received with incredulity; but an investigation will show that the result is in accordance with the law

$$\frac{l^3 \, w}{b \, d^3 \, x} = \text{a constant quantity.}$$

If the girder were supported only in the middle, the deflection of the

half girder would be $\frac{1}{8}$th; but as one-half of the girder cannot deflect without the other half rising, from the action of the chain, it is reduced to $\frac{1}{16}$th; but the girder is not supported at one point only, but at various points, which will still further reduce the deflection.

However, whether this view is precisely the correct one or not, the fact is established, that the deflection of the wave of a girder attached to the chain, and loaded as in the actual bridge, will not exceed $\frac{1}{25}$th of the same girder without the chain, from which we may estimate the weight of a girder sufficient to produce in a suspension bridge or arch the requisite rigidity.

In order to show the importance of this result in the cost of bridges, I will compare the deflection and weight of metal in a bridge similar to the Londonderry Bridge, with a girder of equal span, in each case assuming that 3 tons per foot on the bridge will bring no strain exceeding 5 tons per inch on the metal.

	Tons.
The weight of chain, such that 3 tons per foot on the girder will not exceed 5 per inch, is (see Appendix B),	150
The weight of girder sufficient to give no wave or deflection greater than 1·32 with 100 tons (see Appendix A),	150
The weight of metal in cast iron columns, so that the greatest compression with 3 tons per foot is 4 tons per inch (see Appendix C),	60
Weight of suspension bars, so that the tensile strain does not exceed 5 tons per inch with 3 tons per foot load (see Appendix D),	15
	375
To this has to be added the value of the cost of the anchorage of the chains, (which in the Londonderry Bridge will be 15 per cent. of the iron work of the main girder portion of the bridge), so that I have added 57 tons to represent the value of the cost,	57
	432

To compare this weight with that of a girder alone of the same length and depth as that used, which would be equally rigid with the suspension girder, we have to multiply $150 \times 25 = 3750$ tons, or more than 8 times the amount of metal; but it may be correctly argued that a simple girder would be made deeper, and it is therefore fairer to make the comparison with an actual girder, of which we have an example nearly the same span in the Britannia tube.

The weight of the pair of Britannia tubes is 3100 tons, or more than seven times the amount—a difference which will be received with surprise; but it is perfectly consistent with the fact, that the Derry Bridge has nearly three times the depth, and has 2660 tons less of its own weight to support.

The weight of metal in the Londonderry Bridge does not, in fact, exceed that of the sides of one of the Britannia tubes without the top and bottom webs.

It should be observed, that the proportion of the cost of anchorage will vary under different circumstances, but in the case of the Londonderry Bridge it will be under 15 per cent.

It should also be noticed, on the other hand, as a set-off to the cost of anchorage, that the foundations will be increased in a girder bridge, from

their having to support 3110 tons, as compared with 432 tons in the suspension bridge, which will produce an amount in saving, in average cases, equal to the anchorage.

We will now compare the rigidity of the suspension bridge with that of the tube.

The deflection from 1 ton per foot all over the suspension bridge (see Appendix A) will be $1\frac{1}{2}$ ins.

The deflection of one of the Britannia tubes from 1 ton per foot all over is $3\frac{1}{4}$ ins.

The greatest wave that will be produced by a train of 200 tons, covering one-half of the Londonderry Bridge, the other portion being unloaded, will be readily found from the experiments.

The calculated deflection of the girder, with 200 tons all over, separate from the chain, is 41·25 ins. (see Appendix A) $\frac{41 \cdot 25}{25} = 1 \cdot 65$, the greatest deflection of the wave, if the girder is simply suspended from the chain; but as the chain in the actual bridge is attached to the girder for nearly one-half the length, the rigidity will be much greater than here indicated.

It thus appears that the deflection of the Londonderry Bridge, with a suspended girder, and loaded all over, equals the wave when the Bridge is half loaded; and they are each about half the deflection of one of the Britannia tubes when loaded all over, with the same weight per foot.

It is necessary to explain that the estimate given of the deflection of the Britannia tube, assumes that they act separately; when united at the top they become suspension girders, and the deflection is reduced. On the other hand, it has to be noticed that I have not taken into account the increased rigidity from uniting the girder to the chain, instead of simply suspending it, which will have a most material influence.

I will also call attention to the fact, that, in estimating the deflection of the Londonderry Bridge, I have treated the point of support as a fixed point, which is the case if all the spans are equally loaded; but in the event of one span being loaded, and the adjoining span unloaded, the point of suspension will not be a fixed point, and the deflection will be greater than I have estimated.

Thus, with one span loaded, and the second unloaded, the girder bridge will show a comparatively better result than with the entire bridge loaded, but not to any sensible amount, as the same property which renders the suspended girder rigid, will prevent the movement of the point of suspension.

The weight on one opening will create a disposition to straighten the chain in the adjoining opening, which will be resisted by the girder so effectually, from being united with it, that little motion of the point of suspension will occur, even if no assistance were given by the tower.

We may make a similar comparison, deduced from other large girders, of which the next largest actually erected is the Boyne Viaduct; here the span is 264 feet; weight of effective metal, 300 tons.

To find a girder of equal depth and rigidity of 440 ft. span, we have

as—264^3 : 440^3 : : 300 : 1388 tons, the weight of a girder being continuous that would deflect 1·9 inches with 540 tons all over, or of about two-thirds of the rigidity of the Londonderry Bridge. The Boyne Viaduct thus indicates a much more favorable result than the tube, and as the system would admit of greater depth, much less metal would suffice for the span.

A similar deduction may be made from the Newark Dyke Bridge, which has: Span of opening, 240 ft.; weight of metal 244½ tons.

Here we have, as—240^3 : 440^3 : : 244½ : 1506 tons, the weight required to construct a girder that will deflect 2¾ ins. with 240 tons; and indicates also a more favorable result than the solid-sided girder, but not equal to the Boyne Viaduct.

I must not conclude these comparisons without referring to Mr. Brunel's new system of combining an arch and a suspension chain, giving each half the duty.

There is no doubt in the case of the proposed Londonderry Bridge, if the chain was reduced to half the section, and an arch of the depth of the chain was substituted, and the suspension rods extended to the arch, that theoretically with the same metal, there would be equal strength and rigidity; but the real difficulty is the impracticability of such a construction, the metal is an arch of 451 feet span and 80 feet rise cannot be measured by the section as in a chain, from the tendency to buckle, and from having to contend with its own weight.

Thus in the Saltash Bridge, which is now in course of construction on this principle, of 451 feet span, the depth is only 56 feet, or little more than one-third of the Londonderry Bridge, if of that construction, and thus nearly three times the metal is required to give equal strength, and nearly nine times to give equal rigidity from the deflection varying as the square of the depth.

It will be observed that there will be no difficulty in giving even a greater depth to a suspension bridge; the vertical pressure or weight of the bridge is small compared with the pressure on the arch of Mr. Brunel's girder; and, as the height is only 88 feet, no practical difficulty arises.

(To be Continued.)

For the Journal of the Franklin Institute.

The First Locomotives in the United States

Were brought over from England by Horatio Allen, of New York, in the fall of 1829 or the spring of 1830; and one of them was set up on the Delaware and Hudson Railroad, at Carbondale, Pennsylvania, but being found too heavy for the track, its use was abandoned. The first locomotive constructed in this country, was built by the West Point Foundry, at New York, in 1830, for the South Carolina Railroad, and named the *Phœnix*—a second engine was built the same year, by the same establishment, and for the same road, and named the *West Point.* In the spring of 1831 a third engine was built by the same establishment,

for the Mohawk and Hudson Railroad, from Albany to Schenectady, and called the *De Witt Clinton;* this was the first locomotive run in the State of New York. This engine was put on the road by David Matthew, who now resides in this City, and has been connected with railroads since that time. The first Stephenson locomotive ever imported into this country was the *Robert Fulton;* this engine was brought out in the summer of 1831, for the Mohawk and Hudson Railroad, subsequently rebuilt and named the *John Bull.* B.

AMERICAN PATENTS.

List of American Patents which issued from February 2d, to February 23d, 1858, (inclusive,) with Exemplifications.

FEBRUARY 2.

1. For an *Improvement in Clamps for Holding Ladies' Hair in Curl;* Francis Arnold, Middle Haddam, Connecticut.

Claim.—"The device for curling the hair, consisting of a tube provided with elastic straps."

2. For an *Improved Tool for Manufacturing Splint Baskets;* Artemas Baker, Templeton, Massachusetts.

Claim.—"The tool consisting essentially of the guide, the plate, and the horizontal iron, with its inclined edge, in connexion with a horizontal recess and opening."

3. For an *Improved Carpet Stretcher;* Herman Blau, Washington, D. C.

Claim.—"My greatly improved and double extensible carpet stretcher, composed of the combined notched bars, and the fork-armed ratchet lever, combined with each other."

4. For an *Improvement in Machines for Forming Bonnet Frames;* Sewall H. Bowker, Worcester, Massachusetts.

Claim.—"The row of pins or hooks, or their equivalents."

5. For an *Improvement in Jack Screw Presses;* J. W. Bocage, Pine Bluff, Arkansas.

Claim.—"The arrangement and combination of the follower, toothed rack bar, pinion, grooved pulley, and windlass, for the purpose of rendering the follower capable of pressing upward and self-lowering. Also, giving the toothed rack bar a gradual taper on each edge from bottom to top, so that it shall contain less metal and require less power to raise it."

6. For an *Improved Shingle Machine;* David M. Boyd, Indianapolis, Indiana.

Claim.—"The arrangement and combination of the reciprocating sliding frame, with the wheels, when the parts, or their equivalents, are all arranged as a whole."

7. For an *Improvement in Cultivator Teeth;* Moses Bucklin, Grafton, N. H.

Claim.—"A cultivator tooth having two shares which rise with a curve, so as to form semi-mould-boards, with their front edges terminating in a single perpendicular plane or cutter, and in combination with said plane or cutter extending forward with a straight cutting edge rising from the points of the shares at an angle of about thirty-two degrees, and terminating at the top in a flanch on each side connected with the tops of the semi-mould-boards, for the purpose of fastening the tooth to the frame of the cultivator."

8. For an *Improvement in the Mode of Forming the Bat for Making Felt Cloth;* Thomas B. Butler, Norwalk, Connecticut.

Claim.—"The arrangement of the machines, or their equivalents, operating in combination, for the purpose of forming a bat, by the interposition of a layer or sliver of diagonal fibres between the alternating layers of longitudinal and transverse fibres."

9. For an *Improvement in Brick Machines;* Charles Carnell, Philadelphia, Penna.

Claim.— "1st, The piece, in two divisions, composed of three plates and the friction pins, arranged alternately in combination with the levers and adjustable lugs, so as to give said levers any required amount of motion. 2d, In combination with the feeding device, the clutch, and the forked rod. 3d, In combination with the feeding device and carriage, the guide and revolving table for receiving the filled moulds from said carriage, and delivering them at the side of the machine."

10. For an *Improvement in Reducing the Friction of Journals of Axles on Railways;* L. J. P. De Mirimonde, Paris, France; patented in France, August 23, 1856.

Claim.—"Placing the bearings in which the journals of the friction rolls run, within the axle box, and supporting them in the shell of said box. Also, in combination with the axle or journal, the hanging of the friction rolls independent of each other, so that when the weight comes unequally upon them by the rocking of the rolling stock, one shall not wrench or cramp the other and cause it to cut. Also, the causing of the axle itself to take and carry up the lubricator from the reservoir to the journals of the friction rollers, and supplying itself through said friction rolls. Also, in combination with the journal, the sectional ring and solid one, with its flexible covering, as a carrying device for taking and carrying the oil from the reservoir to the journals of the friction rolls."

11. For an *Improved Bread Cutter;* Matthew Chapman, Greenfield, Mass.

Claim.—"The rotating knife and bed placed on the shaft, when used in connexion, and arranged relatively with the platform and hopper or opening."

12. For an *Improvement in Hot Air Furnaces;* George Darby, Augusta, Maine.

Claim.—"The combination of a hollow cold air auxiliary draft flue, two deflecting radiating plates, and a pivoted perforated damper."

13. For an *Improvement in Stoves;* Rufus Dawes, Washington, D. C.

Claim.—"The combination of the outer bars and the inner bars, arranged so as to admit an air passage through the fuel, and an air passage between the outer bars and the casing, for the purpose of supplying the inner and outer surfaces of the fuel with air, by which arrangement the combustion of smoke is effected."

14. For an *Improvement in Mode of Laying Railroad Tracks;* F. P. Dimpfel, Philadelphia, Pennsylvania; patented in France, Oct. 27, 1856.

Claim.—"The clamping of each line of rail between two lines of string timbers, into which the rails are fitted, so as to receive not only a lateral but a vertical support therefrom, both at the base and head, thereby increasing the bearing surface of the rail, keeping the several lengths of rail in place at the joints, and other parts, enabling a lighter rail to be used than that ordinarily employed, and making a less solid and at the same time a less flexible track."

15. For an *Improvement in Corn Planters;* Nathanial Drake, Newton, New Jersey.

Claim.—"1st, The agitator, arranged with relation to the seed boxes and valves. 2d, Combining with one of the weights which operate the valves, or its equivalent, a cam shaped gear wheel corresponding in form with the cams which operate said weights."

16. For an *Improvement in Wheelwrights' Machine;* N. T. Edson, New Orleans, Louisiana.

Claim.—"The form, or its equivalent, in combination with the press."

NOTE.—No idea of the nature of this invention can be had except from the whole specification."

17. For an *Improvement in Gumming and Jointing Saws;* Hosea O. Elmer, Mexico, New York.

Claim.—"Constructing the bed or frame of two parallel bars connected at their outer or front ends by a bolt, and having a suitable space allowed between them, when said bed thus constructed is used in connexion with the guard or guide attached to its inner end, for the purpose of preventing the teeth of the saw being injured by coming in contact with the plates, as the bed is adjusted upon or to the saw."

18. For an *Improved Method of Attaching the Electrodes to the Poles of Galvanic Batteries;* Joseph Elmendorf, Penn Yan, New York.

Claim.—"The method of attaching the electrodes by means of a fusible alloy."

NOTE.—Said alloy is composed of 20 parts tin, 10 cadmium, and 1 bismuth."

19. For an *Improved Gold Amalgamator;* Joseph H. Fisher, Placerville, California.

Claim.—"The employment of a rotating cylinder having its face or periphery of silver, or other suitable metal, and placed within a wheel, or arranged in any suitable or equivalent way, so as to receive the wash from the crusher, and unite by amalgamation the globules of alloy that escape with the wash from the crusher."

20. For an *Improvement in Rotary Steam Engines;* Levi F. Goben, Spring Hill, Missouri.

"This invention consists in the peculiar combination of devices."

Claim.—"The double branched sliding abutment, roller, flanched wheel, stud, arm, and oscillating valve stem."

21. For an *Improvement in Cultivators;* James Houk, Clinton, Indiana.

Claim.—"The arrangement of the triangular mould-board and its adjustable standard, with relation to beam, standards, handles, and shovels."

22. For an *Improvement in Damper Regulators;* James How and Charles W. Copeland, Brooklyn, New York.

Claim.—"A flexible or flexible and elastic tube closed at both ends and in connexion with a steam generator, in combination with a presser block and a bed-plate, constructed as a whole, and applied to regulate the quantity of air delivered to a furnace, or as a pressure indicator."

23. For an *Improvement in Apparatus for Hoisting Ice;* Augustus Hunt, Philadelphia, Pennsylvania.

Claim.—"1st, The employment for raising and delivering ice, of two cradles so arranged in connexion with any suitable driving apparatus, that one shall ascend simultaneously with the descent of the other, said cradles being so constructed and arranged as to retain and deliver the ice without the aid of assistants. 2d, Forming that portion of the cradle on which the ice rests with an incline, and combining that incline with the retaining and releasing levers, or their equivalents."

24. For an *Improvement in Grain Mills;* James J. Johnston, Alleghany, Penna.

"This invention consists in the arrangement for feeding the grain at the hub of the stationary bur, and also, in the arrangement for gathering, bolting, and separating the flour."

Claim.—"1st, The use of the pin on the revolving bur, for the purpose of operating the bolting sieve and spring rod. 2d, The arrangement of the hopper, spring rod, hollow hub, and feed screw. 3d, The arrangement of the recess in the burs and flanch on the stationary bur, for the purpose of forming the gathering chamber. 4th, The arrangement in the face of the bars of the recess with the blank surface, in connexion with the arrangement of the teeth or cutters and rubbing surfaces. 5th, The arrangement of the spring, the holding sieve with the recesses, and the chutes."

25. For an *Improvement in Plate Frames for Photographic Cameras;* Wm. and Wm. H. Lewis, City of New York.

Claim.—"The cut-off of opaque glass, or equivalent material, in combination with a suitable spring, by which said cut-off is made to close the aperture through which the slide passes. Also, securing the corners of glass, or equivalent material, into the frame by means of the rib and groove."

26. For an *Improved Corn Sheller;* Joseph R. Lindner, Cincinnat, Ohio.

"My invention consists in the construction and arrangement of an elastic case encircling the drum, whereby efficient action is combined with simplicity and compactness."

Claim.—"The elastic case, in combination with the concave and drum."

27. For an *Improved Invalid Bedstead;* George Miller, Fremont, Ohio.

Claim.—"The three frames, in combination with longitudinal pieces, connecting pieces, secondary frame springs, and drawing mechanism. Also, in combination with the foot-piece of the bed, the roller and plate attached thereto."

28. For an *Improvement in Hemp Brakes;* Solomon P. Moore, Arrow Rock, Missouri.

Claim.—"So corrugating the contiguous faces of the brakes in a transverse direction to the general line of the feed and general line of the longitudinal surfaces of said brakes, as to prevent the fibres or stalks from escaping the proper action of the machine by a change of direction, when combined with the brakes vibrating in relation to each other."

29. For an *Improvement in Tobacco Presses;* W. R. Musser, Baltimore, Maryland, and J. Coleman, Lynchburgh, Virginia.

Claim.—"The application of the levers, the sheath over which the chain passes, said chain being connected to the end of lever, the braces to retain the pressure, and the movable truck passing under the press. Also, the combination of the whole as a new and useful machine for mechanical purposes."

30. For an *Improved Washing Machine;* W. W. Neal, Yellow Springs, Ohio.

Claim.—"The arrangement and combination of the rubber, connecting bar, crank, yielding standard, (or its equivalent,) and yielding suspending rods."

31. For an *Improvement in Flasks for Casting Wheels;* F. Nishwitz, Brooklyn, New York.

Claim.—"The employment of guides or sockets of metal or wood attached to the flask, to receive and hold the shaft or axle within the sand mould, independently of the sand."

32. For an *Improvement in Harrows;* Samuel J. Orange, Grayville, Illinois.

Claim.—"The combination of the two harrows with the connecting bar, or its equivalent, when the harrows are so hung as to produce by their connexion with it, and thereby with each other, a continued rotation of both harrows."

33. For an *Improvement in Railroad Car Brakes;* Nathanial Potter, Hillsdale, Mich.

Claim.—"The combination of the balls and stops with the chains and 'oscillator.'"

34. For an *Improvement in Making Railway Bars;* Thomas E. Purchase, Reading, Pennsylvania.

Claim.—"The manufacture of railroad rails from a pile, the top bar of which is of a superior quality of iron, immovable laterally, and sufficiently heavy to give the rail when rolled a consolidated head, connecting with the lower layers in the stem of the rail."

35. For an *Improvement in Ploughs;* J. O. Ramage, Lafayette, Alabama.

Claim.—"Connecting the piece R. with the stock by point and cavity, and passing a bolt on the bottom of the same through opening I, and the slot of the plough point, whereby the said piece is made to perform the functions of root cutter, brace, and securer of the plough point."

36. For an *Improvement in Safety Winch;* Wm. Riker, Penn Yan, New York.

Claim.—"The means used to operate the pawls, also the ratchets, when used in combination with the devices above mentioned."

37. For an *Improvement in Adjustable Axle Brace for Carriages;* F. O. Rogers, Elmira, New York.

Claim.—"The lever, when constructed, arranged, and operating in combination with the body, springs, axle, and braces of the carriage."

38. For an *Improved Saw Gummer;* N. F. Stone and W. C. Ward, Menard County, Illinois.

Claim.—"So combining the levers, screw clamp, bur and clamping disks in one machine, as that the operator may keep the bur up to the saw plate whilst the apparatus is clamped thereto."

39. For an *Improvement in Lamps;* J. Stuber and R. Hughes, Utica, New York.

Claim.—"1st, So constructing and arranging the upper half of the feed pipe of a spring or mechanical lamp, as that the lower half will be free to slide to the top, or nearly so, of the wick tube, for the purpose of lessening the height of the latter, and of rendering the lamp more compact. 2d, The arrangement and combination of the elastic strip pin and slot with the rods and loops, for the purpose of forming an elastic piston for the lamp."

40. For an *Improvement in Fastening for Window Sashes;* F. Thrasher and H. B. Horton, Akron, Ohio.

Claim.—"The friction strip, riding upon an inclined plane and operated by a spring, so as to be self-locking, for the purpose of fixing the window sash at any desired height."

41. For an *Improvement in Turning Tables for Railways;* W. H. Ward, Auburn, New York.

Claim.—"1st, The combination of the turning platform, arranged without a central pivot, or its equivalent, and the ground circular tracks, the sides of which form inclined planes sloping towards the centre of the grooves, with a series of balls arranged in the grooves, whereby the platform of the table is free to yield laterally to shocks, and again resumes its central position. 2d, The combination of the curbing with the platform track and balls. 3d, The combination of the clamping mechanism with the turning platform, by which the table may be stopped in any part of its revolution, and the lateral movement gradually arrested. 4th, The combination of the clamping mechanism with the bell cranks and connecting rods, or their equivalents, by which all the clamps are simultaneously brought into action by either of the clamping levers."

42. For an *Improvement in Water-proof Gaiter Shoes and Boots;* Thomas C. Wales, Dorchester, Massachusetts.

Claim.—"A new or improved manufacture, or water-proof vulcanized rubber and cloth gaiter shoe, made in the manner, and with its external layer of cloth and its lining of cloth arranged together, and with respect to the remainder or rubber parts or boxing."

43. For an *Improvement in Manufacturing Angular Paper Boxes;* Elisha Waters, Troy, New York.

Claim.—"The construction of angular boxes of paper board, by cutting the board into strips for the sides, and pieces for the tops and bottoms, forming the upright angles one by one by pressing the strips between angular disks without cutting, creasing, or scoring the board, and, finally, cementing the parts together, thus producing by the use of only a single set of the dies, and with the least waste of the paper board, any required number of different sizes of many-sided boxes with smooth, solid, upright corners."

44. For an *Improvement in Machines for Drafting Garments;* James M. Weston, Chesterfield, New York.

Claim.—"The adjustable curved plate or arm and index pointer, in combination with bed rule and connecting rule provided with their several scales."

45. For an *Improvement in Shifting Belts;* Morris Wells, Brooklyn, New York.

Claim.—"The arrangement of the shifting bar, spiral spring, pulley, bolt, and cords, within and relatively to the box, whereby the whole of the shifter is brought within a very small compass, and in such convenient form that it can be very readily attached in any convenient place."

46. For an *Improvement in Dressing Mill Stones;* Isaac Whissen, Mount Jackson, Virginia.

Claim.—"The construction of a mill-dress having a central sloping draft circle with para-centric curves proceeding therefrom, and terminating in main and branch furrows formed by the mathematical divisions, sub-divisions, and especial angular calculations."

47. For an *Improvement in Seed Planters;* Joseph H. Wiggin, Boston, Massachusetts.

Claim.—"The arrangement of the seeding cylinder and toothed bar for planting seed automatically."

48. For an *Improved Method of Feeding the Bolt in Shingle Machines;* Twentyman Wood, Greenwich, Connecticut.

Claim.—"The combination of the notches or corrugated guides with arms, or their equivalents, and an apparatus for setting the block forward to the knife."

49. For an *Improvement in the Mode of Operating Pistons of Pumps;* Simeon Wood, Worcester, Massachusetts.

Claim.—"The combination of the weighted disk with the system of wheels, the floor, and the protruding inclined planes, or their equivalent."

50. For an *Improvement in Furnaces for Locomotives;* O. W. Bayley, Boston, Mass., Assignor to the Boston Locomotive Works.

Claim.—"The water space perforated cone as connected with the crown sheet, and in connexion with a tight furnace bottom."

51. For an *Improved Apparatus for Paying Out Telegraphic Cables;* Louis Brauer, Assignor to self, Louis Brandenburg, and James B. Stewart, Washington, D. C.

Claim.—"The arrangement of the spring pulley frame with the paying-out apparatus,

and the valves of both the paying-out engine and propelling engine, or either of the same separately."

52. For an *Improvement in Cotton Presses;* James A. Disbrow and James E. Cronk, Assignors to J. A. Disbrow, aforesaid, Poughkeepsie, New York.

Claim.—"The arrangement of the drums, ropes, and follower, whereby the ropes are made to serve the double function of lateral supports, and as a means of connecting the follower to the gearing or driving parts. Further, applying the power to the follower by means of the rotating press box and base, annular rack, gearing, in connexion with the drums and ropes, or their equivalents."

53. For an *Improvement in Diaper or Shawl Pins;* John G. Klinger, Jersey City, New Jersey, Assignor to Ignatius Sturn, City of New York.

Claim.—"The spiral shield, the stops, and friction detent."

54. For an *Improvement in Harrows;* Jabez Robins, Assignor to self, D. K. Haines, and S. Richardson, Leominster, Massachusetts.

Claim.—"A rotary wheel harrow as made with its toothed rim in sections, adjustable with reference to the axis of the wheel, in order that the dimensions of the wheel may be varied. And with a wheel made adjustable, as specified, I claim so applying the roller weight to its supporting arm as to enable the weight to be adjusted nearer to, or farther from, the centre of the wheel with reference to the adjustable rim."

55. For an *Improved Method of Preparing Blanks for Shoe Pegs;* B. F. Sturtevant, Assignor to self and Elmer Townsend, Boston, Massachusetts.

Claim.—"The process of making blanks for shoe pegs, by sawing and glueing up the material. Also, the method of securing the blanks in packages, by means of bands of adhesive paper, or their equivalents, whereby the blanks may be placed in the machine, and removed therefrom in bundles."

56. For an *Improvement in Manufacturing Sewing Silk;* H. Kelsea, North Branch in Antrim, New Hampshire, Assignor to self and Henry Dunklee, Assignors to D. B. and J. C. Fuller, City of New York.

Claim.—"My improved manufacture of silk twist or sewing silk, as made by looping and interlooping a single strand, and subsequently twisting it into one line or cord."

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57. For an *Implement for Holding Open Shoes, Bags, &c.;* John Allender, New London, Connecticut.

Claim.—"A pair of forceps, with one jaw provided with a plate for the inside of a shoe, sack, or other article, the other jaw carrying two arms, one to clamp the shoe, sack, or other article, against the first mentioned jaw or plate upon it, and the other arm carrying a bar or plate to spread the opening in the shoe, sack, or other article. Also, making the bar that carries the arm that spreads the shoe, sack, or other article, adjustable, so that the forceps or apparatus may be adapted to shoes and sacks of varied sizes."

58. For an *Improvement in Sewing Machines;* Benjamin J. Angell, Attleborough, Massachusetts.

Claim.—"The combination of the grooves of the presser with the barbs (of the feed bar), and the surfaces with the thumb-screw."

59. For an *Improvement in Pumps;* Wm. Boyers, Mount Carroll, Illinois.

Claim.—"The combination of the connecting chain with the lifting rods, and with double pistons working in a single cylinder."

60. For an *Improvement in Hydro-carbon Vapor Lamps;* Robert R. Crosby, Boston, Massachusetts.

Claim.—"Combining an auxiliary and separate reservoir with the main reservoir, and its main and auxiliary wick tubes, so that while a fluid rich in carbon may be used in the main reservoir, alcohol, or a fluid having less or very little carbon, may be used in the auxiliary reservoir, and be burned on the wick thereof, extending through the auxiliary wick tube. Also, arranging the separate auxiliary reservoir of the auxiliary wick within, and separate from, the main reservoir. Also, the arrangement and appli-

cation of a flame guard to the auxiliary wick tube chamber, so as to extend and slide around the upper part of said chamber, have such chamber open beneath it, and operate to spread the heat uniformly against the under side of the vaporizing vessel."

61. For an *Improvement in Cards for Currying Cattle;* C. S. Dickerman, Lansingburgh, New York.

Claim.—"As a new article of manufacture, a hand card, consisting of a flat wooden stock, having straight wire teeth forced into, but not through, the stock, and provided with a handle, or its equivalent, to fit the card for hand use."

62. For an *Improvement in Grinding Mills;* H. V. Duryea, Fulton, New York.

Claim.—"The method of constructing metallic rollers for grinding mills, when the parts of each roller are connected by the contraction of metallic rods. Also, the method of attaching the hopper with the rollers. Also, the method of attaching hoppers in combination with rollers."

63. For an *Improvement in Railroad Car Axle Boxes;* George W. Geisendorff, Indianapolis, Indiana, and Jacob C. Geisendorff, Cincinnati, Ohio.

Claim.—"The lug, or equivalent device, in combination with the axle and box."

64. For an *Improvement in Lubricating Apparatus for Journal Boxes of Railroad Cars;* Jacob C. Geisendorff, Cincinnati, Ohio.

"My invention consists in an arrangement for rotating a lubricating roller by the concussion incident to the motion of the car."

Claim.—"The guards, springs, ratchet-wheel, and pawls, or equivalent devices, in combination with the lubricating roller and axle."

65. For an *Improved Machine for Cutting Tenons on Spokes;* Mahlon Gregg, Philadelphia, Pennsylvania.

Claim.—"Securing the cutters at an angle. Further, the combination of cutter carrier, bearer, and tubular piece."

66. For an *Improved Shingle Machine;* Wm. Gregor, City of New York.

Claim.—"The arrangement of two slides turning upon centres, and acted upon by inclined surfaces, which latter are operated by the motion of the bed-plate. Further, the attachment of a double-edged knife to the bed-plate, moving back and forth with said bed-plate, and at the same time being acted upon by the above mentioned slides."

67. For an *Improvement in Potato Planters;* Edward E. Hawley, New Haven, Conn.

Claim.—"1st, The combination of the planting wheel with the knife or cutting blade to effect the purpose. 2d, The combination of the planting wheels with the hopper, when arranged in relation to each other."

68. For an *Improvement in Alarm Locks;* Horace L. Hervey, Windsor, Connecticut.

Claim.—"1st, The main lock bolt, or its equivalent. 2d, The sliding notch wheel. 3d, The slide piece, when used in connexion with sliding spring knobs. 4th, The sliding spring knobs. 5th, The sliding spring ratchet."

69. For an *Improvement in Musical Instruments;* Ureli C. Hill, Jersey City, New Jersey, and Charles F. Hill, City of New York.

Claim.—"1st, The wing and hammer wire to fork prongs, as used in this instrument. 2d, The placing of keys, action, and cells, in lateral or oblique ranges, the cells and keys crossing each other at right angles—and the manner of suspending cells. 3d, The yoke and method of holding the fork to the cell. 4th, The arrangement of dampers and damper levers to the keys and forks, so as to damp the forks on their edges. 5th, The transverse upright action for the movement of hammers across instead of parallel with the keys."

70. For an *Improvement in Hominy Mills;* Philip Homrighaus, Royalton, Ohio.

Claim.—"The construction of the gauge plate, when used in connexion with the hopper and trough."

71. For an *Improvement in Harvesters;* M. G. Hubbard, Penn Yan, New York.

Claim.—"The attachment of the spring directly to the finger-bar, and placing the shoe on one side thereof, and directly in the track of the supporting wheel."

72. For an *Improved Washing Machine;* Edward Julier, McConnelsville, Ohio.

Claim.—"The construction and arrangement of the sliding carriage, composed of the side pieces, the compensating yoke, the pressure spring piece, the plain roller, the ratchet roller, the compensating roller, the staff rod, and notched pressure beam and weight, combined and operating together with the driving pitman rod. Also, the jointed shoulder pieces, the elbow lengths, and fore-arms, when arranged and operating in connexion with an ordinary wash-tub or board."

73. For an *Improved Method of Straining Reciprocating Saws;* G. P. Ketcham, Jr., Bloomington, Indiana.

Claim.—"Connecting the slides at both ends of the saw to crank pulleys on the shafts, by means of pitman, the opposite ends of the shafts being connected by the cranks, and pitman or pitmans, whereby the shafts are made to move simultaneously, and the same relative positions of their cranks and working parts, connected therewith, retained at all points of their movement, and the saw, operated or driven, and kept equally strained, or at the same degree of tension at all points of its stroke."

74. For an *Improvement in Removable Window Sash;* Robert H. Kirck, Utica, New York.

Claim.—"Jointing the sash or sashes of a window at the centre, so that they may be removed from the casing without detaching the parting beads or stop strips, the sash or sashes being provided with a catch, or any equivalent device, to prevent the casual folding of the same."

75. For an *Improvement in Scrapers for Grinding Mills;* Thomas E. Tittle, Janesville, Wisconsin.

Claim.—"The employment of the rotating head, having rods and scrapers attached, said parts being arranged to revolve slowly around the runner at whatever speed the latter may be driven."

76. For an *Improvement in Flour Bolts;* Samuel G. McMurtry, West Urbana, Ill.

Claim.—"The arrangement of the bolt frame, bottom plate, flanches, plates, and spouts, whereby the current of air is prevented from drawing through the centre of the bolt, but is spread so as to pass along near the surface of the bolting cloth, while the flour is not only suspended in a current of dry air, but is conducted through the cloth out upon the annular plates, and down the peculiarly arranged air-tight spouts to the place of storing, nothing whatever being able to escape except through the proper channel."

77. For an *Improvement in the Mode of Operating Railroad Station Pumps;* Wm. McVeigh, Boone, Illinois.

Claim.—"The combination of the roller, inclines, levers, and pump."

78. For an *Improved Method of Attaching India Rubber Soles to Boots and Shoes;* Abram T. Merwin, New Haven, Connecticut.

Claim.—"Securing a sole of india rubber, gutta-percha, or other material, to a shoe, by means of a binder."

NOTE.—Said binder is a strip of sheet rubber passed along the edges of the outer and inner soles, secured by cement.

79. For an *Improvement in the Manufacture of Wrought Iron Railroad Chairs;* James Milliken, Philadelphia, Pennsylvania.

"My invention consists in an improvement in the mode of making the wrought iron chair with continuous lips of the shape invented by Samuel J. Reeves."

Claim.—"The manufacture of railroad chairs, by forming a pile of the side pieces in connexion with the pieces."

80. For an *Improved Clamp for Holding Rectangular Pieces of Wood while being Bored, Tapped, &c.;* Henry Miller, Grafton, Virginia.

Claim.—"The apparatus for adjusting, holding, and clamping bed posts, whilst their previously bored holes are having the screw threads cut therein."

81. For an *Improved Stave Machine;* Elias Moore, Wm. Clark, and James Lindsey, Shelbyville, Indiana.

"This invention consists in the arrangement of a concave knife within a movable

frame work, propelled by steam or other power, so as to economize said power, and cut barrel staves upon the most approved plan."

Claim.—"The combined parts acting as a whole."

82. For an *Improvement in Mode of Burning Bricks;* A. J. Mullen and Robert Hall, Greensboro,' Alabama.

Claim.—"The construction of a brick kiln with an inclined bottom leading to the drawing pit, when used in combination with the irregular setting of the brick in the kiln."

83. For an *Improved Churn;* Enos Page, Streetsborough, Ohio.

Claim.—"The arrangement of the spiral wing dashers on opposite sides and ends of the dasher-shaft, in combination with a cylindrical churn body, in such a manner that the outer radial edges thereof shall respectively sweep (or move in close proximity to,) the ends of the churn body, and their spiral edges sweep respectively one-half the length of the periphery of the churn body."

84. For an *Improvement in Machines for Cutting Brush from Cotton Fields;* Elias Peck, Canton, Illinois.

Claim.—"The arrangement of wheels, knives, cams, and bar."

85. For an *Improvement in Pedals for Organs, &c.;* Thomas Robjohn, City of New York.

Claim.—"The arrangement of organ pedals in the radial and concave form to facilitate the performance thereon."

86. For an *Improved Lead Pipe Machine;* Charles E. Rockwell, City of New York.

Claim.—"Having the space between the adjustable die plate and the base plate covered or protected by the end of the lead cylinder."

87. For an *Improvement in Joints for Sheet Metal Roofs;* Stephen Scotton, Richmond, Indiana.

Claim.—"Forming a three-leaved metal plate shaped thus, **T**, by soldering or rolling iron, or other metal, for securing the joints of metal roofs."

88. For an *Improved Washing Machine;* W. H. Tambling, Berlin, Wisconsin.

Claim.—"The combination of the corrugated or fluted cylinder and elastic or yielding frame, provided with rollers, when the bearings of the axis of the cylinder are fitted in an elastic or yielding and adjustable frame."

89. For an *Improved Painting and Varnishing Machine;* H. Thayer and L. L. Martin, Warsaw, New York.

Claim.—"The mode of flowing paint, size, varnish, or any other liquid substance, on articles of wood or iron, by passing them horizontally, or otherwise, through holes cut in two sides of any vessel, while said vessel is filled with the liquid substance to be used—said holes to be cut directly opposite each other, and to be appropriately packed with flannel, fulled cloth, or any other appropriate packing, and to correspond in shape with the articles to be run through. Also, the funnel-shaped india rubber tube, with its packing, and its application to painting, sizing, and varnishing articles that diminish in size from one end to the other, or that vary in diameter. Also, the hollow brush standing on the further side of the chamber from the operator, and its adaptation."

90. For an *Improvement in Collapsible Boats;* Nathan Thompson, Jr., Brooklyn, New York; patented in England, December 3, 1857.

Claim.—"A sectional collapsible boat, made up of eight or more sections hinged together, and constituting a boat similar in appearance to an ordinary small boat."

91. For *Improved Lap Joints for Belting;* Henry Underwood, City of New York.

Claim.—"The straps placed on the rivets which pass through the outer and inner ends of the laps or 'skived' portion of the parts or ends of the belt, so that the straps may project over the outer thin ends of the laps."

92. For an *Improvement in Grain and Grass Harvesters;* Aaron Van Duzer, Goshen, New York.

Claim.—"The arrangement of cutters and fingers upon both sides of their respective bars, whereby the grass may be cut upon either side of the finger bar."

93. For an *Improvement in Corn Huskers;* F. M. Walker, Greensboro,' N. C.

Claim.—"The cone, armed with the spring teeth, in combination with the guide bars and upright piece."

94. For an *Improvement in Ploughs;* George Watt, Richmond, Virginia.

Claim.—"Constructing the mould-board and land-side of cylindrical surfaces of equal diameters, intersecting along the cutting edge of the plough, in combination with the curved standard."

95. For an *Improvement in Machines for Planting Potatoes;* Thomas B. Whyte, Greenwich, New York.

Claim.—"The arrangement of slide, knife, and adjustable board, with hoppers."

96. For an *Improved Bottle Stopper;* J. B. Williams, City of New York.

Claim.—"A bottle stopper, composed of a metal tube having proper flanches, one end of which is covered with cork, and its top furnished with a ball-valve which moves between guides attached to the tube or its flanch."

97. For an *Improvement in Cotton Gins;* Lewis J. Chichester, Assignor to Henry G. Evans, Samuel Barstow, and Daniel S. Winteringham, City of New York.

Claim.—"The rollers, grooved circumferentially, and having the peripheries of their flanches smooth or serrated, the rollers being fitted together with or without the elastic wings."

98. For an *Improvement in Corn Huskers;* Abbot R. Davis, Assignor to self and B. D. Moody, East Cambridge, Massachusetts.

Claim.—"In combination with the stationary guards, cone, and knife, the elastic spring rests."

99. For an *Improvement in Corn Huskers;* Daniel Lombard, Assignor to self and Geo F. Richardson, Boston, Massachusetts.

Claim.—"A corn husker, constructed of a chuck mounted on a tubular shaft, or provided with a central cavity, and having cutters and spurs arranged with respect to the bore or cavity."

100. For an *Improvement in Fire Arms;* Frederick D. Newbury, Assignor to Richard V. DeWitt, Jr., Albany, New York.

Claim.—"The main spring arranged to operate the hammer and trigger simultaneously, where the hammer is cocked by the trigger. Further, the ratchet-wheel lever and pin in combination, arranged so as to revolve the cylinder, and to hold it firmly in the act of firing. Further, the combination of the main spring, trigger, ratchet-wheel, lever, and pin, for the purpose of cocking the piece, revolving the cylinder, holding it in place, and firing the piece by one movement of the finger upon the trigger."

101. For an *Improvement in Cane Gun;* John F. Thomas, Assignor to self and Samuel Remington, Ilion, New York.

Claim.—"Connecting the case and barrel by means of the hammer and its rod, and the trigger block and trigger. Also, in combination with the case and barrel, the catch spring for holding the case and hammer when the arm is cocked. Also, the continuous grooves or shoulder around the end of the rod, so that said rod may turn in its bearings without preventing the sear from catching it whenever drawn back past it. Also, the combination of the trigger block, trigger with its sear and spring, and the hammer and its rod."

102. For an *Improvement in Hand Corn Planters;* Joshua Fairbank and Edwin C. Durfee, Leon, New York, Administrators of the estate of John B. Fairbank, dec'd., late of the City of New York.

Claim.—"1st, The adjustable measuring cups with a movable bottom operated by the upward motion of the cups relatively to other parts. 2d, The thruster and slide, or their equivalents, when used for giving the side pressure to the corn."

103. For an *Improvement in Hydrants;* Kingston Goddard, Philadelphia, Penna.

Claim.—"1st, The plunger operated upon by a weighted handle, in combination with the self-closing spring valve. 2d, The construction of the shell in two sections, in combination with the removable valve seat piece."

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104. For an *Improvement in the Mode of Connecting the Trucks of Railway Cars;* T. F. Allen, Dyersville, Iowa.

Claim.—"Connecting the trucks of railway cars with each other, and with the bodies of said cars, by means of the diagonal rods and the auxiliary tensions, or the equivalents of said rods, when combined and operating with each other."

105. For an *Improved Signal Lantern;* Daniel Ammen, U. S. Navy.

Claim.—"The peculiar construction and arrangement of fixed colored screens or glasses to bow-sprit cap-lanterns, whereby only one color can be seen from any given point at the same time, which consists in the application of fixed red and green glasses or screens, indicating respectively 'port' and 'starboard' sides, when these colored glasses or screens form arcs of ninety degrees, or thereabout, upon the cylinder of the lantern, and when separated by a white glass or screen forming an arc of forty-five degrees, or thereabout."

106. For an *Improvement in Seeding Machines;* Chester Barton, Savoy, Mass.

Claim.—"The frame provided with the seed distributing device, and having the pressure rollers and driver's stand attached, when said frame is connected with the axle and the shaft or windlass, or its equivalent."

107. For an *Improved Churn;* H. D. Baker, Pittstown Corners, New York.

Claim.—"Operating the dash-rod of the churn through the medium of the oscillating chair, treadle, crank-shaft, groove wheel, and bar connected with lever, when the whole are used in combination."

108. For an *Improvement in Filtering Apparatus;* Charles Ballard, Worcester, Mass.

Claim.—"1st, Increasing the extent of the surface of the filtering medium by folding and supporting the folds. 2d, The combination of the pipes and heads having passages with the case."

109. For an *Improvement in Rollers for Window Shades;* J. B. Bailey, City of New York.

Claim.—"The application of an india rubber band, or equivalent substance, on the plane of the pulley, in combination with the endless band or cord, for the purpose of rolling and unrolling a curtain."

110. For an *Improved Ore Washer;* Henry Barnard, Morristown, New York.

Claim.—"The series of pans of sizes graduated, attached to the upright shaft, which receives a combined rotary, reciprocating, and vibratory motion, by which varying degrees of agitation are given to the pans."

111. For an *Improved Gold Washer;* Henry Barnard, Morristown, New York.

Claim.—"The employment of a series of pans furnished with a series of annular retention rims, projecting from their upper sides, and arranged one below another, fast on a horizontal, revolving, and vibrating shaft, and being alternately larger or smaller in size than one another from the top to the bottom of the series, and alternately inclined inward and outward, or made concave and convex."

112. For an *Improvement in Railroad Snow Ploughs;* J. K. Babock, Honeoye Falls, New York.

Claim.—"Forming the body of the plough or device of two boxes mounted on the truck, so that said boxes may be tilted, for the purpose of readily discharging their contents. Also, in combination with the boxes, the inclined plane mounted on wheels and applied to the truck. Further, attaching the doors to the boxes, by means of the rods fitted in the pivoted bearings at one end, and provided with hooks at the opposite ends, whereby the doors are rendered capable of being adjusted either parallel with each other, and forming sides for the boxes, or in oblique positions to form mould-boards or deflectors."

113. For an *Improvement in Hangers for Shafting;* William B. Bement, Philadelphia, Pennsylvania.

Claim.—"The construction of the single stem carrying the box, and so arranging it

relatively with, and connecting it to, the hanger or support by the bushing—that the box and shaft shall have a co-operative self and universal line adjustment with each other, and the shaft have an universal positive adjustment, so as to be moved readily to find any and every point or location within the required limits, and be secured therein, and so that the line of the shaft may be placed and run above the support or below the hanger to constitute it a long or short one, and also receive any and every line and self-adjustment positions within a complete horizon or circle."

114. For an *Improved Machine for Making Cigars;* Louis Beauché, Paris, France; patented in France, May 22, 1856.

Claim.—"Forming the core of cigars, and covering the same with tobacco leaves, so as to acquire a perfect shape by means of the apparatus, consisting mainly of endless bands made of india rubber, or any other suitable yielding substance, revolving in contrary directions, so as to gather the tobacco for forming the core under required pressure. Also, at or near the ends of the covering bands, shaping dies, which are so constructed as to allow the leaves to be fed in and between them to give a perfect form to the conical end of the cigar. Also, the arrangement of knives on each of the frames supporting the band rollers. Also, the general arrangement of parts constituting a cigar-making machine."

115. For an *Improvement in Powder Flasks;* J. H. Breckenridge, Meriden, Conn.

Claim.—"The combination of a chambered cut-off with a receptacle or flask and a delivery tube, the whole constituting an apparatus for charging fire arms."

116. For an *Improved Rotary Blast-producing Chair;* L. R. Breisach, City of New York.

Claim.—"The combination of portable rotary chairs with double-acting two pairs of side bellows, and the mechanism by which, with little muscular exertion, constant currents of air are obtained for cooling the operator."

117. For an *Improvement in Harvesters;* Albert D. Briggs, Springfield, Mass.

Claim.—"The combination of the intermittingly vibrating gate, intermittingly moving apron, and adjustable plates placed over the apron."

118. For a *Machine for Cutting Key-boards, &c., of Musical Instruments;* Derwin E. Butler, Chesterfield, Ohio.

Claim.—"The use of the spacing plate with ranges of holes, but one range of which shall conform to, and correspond with, the musical chromatic scale, and the other with the mechanical divisions of the key-board and its frame, in combination with the carriage and platform, the oscillating frame and tool mandrel, and the vertical bar (said carriage having a longitudinal and transverse motion), and the whole operated by the mechanical devices described, or their equivalents."

119. For *Improvements in Propelling Canal Boats;* Herman Camp, Dunkirk, New York.

Claim.—"1st, The arrangement and location of the propelling wheel and its supporting frame at or near the centre of the boat. 2d, Supporting the engine upon the vertically moving frame. 3d, The combination of the flexible steam-pipe with the stationary boiler and the vertically moving engine."

120. For an *India Rubber Door Mat;* Edwin M. Chaffee, Providence, Rhode Island.

Claim.—"The mat, as formed by ridges or grating, together with the cells or spaces of whatever form, the one to serve as scrapers to clean the foot, and the other to contain the dirt, whether of rubber, gutta-percha, or other flexible gums."

121. For an *Improvement in Metallic Window Shutters;* John B. Cornell, City of New York.

Claim.—"Constructing metallic shutters, doors, &c., of double casings of sheet metal, combined with a frame composed of T shaped metallic bars."

122. For an *Improved Shingle Machine;* George Craine, Fairfield, Iowa.

Claim.—"In combination with the pivoted reciprocating cradle, the pawl lever, ratchet and its shaft, for tilting said cradle alternately from one side to the other, to form the butts and points of the shingles. Also, in combination with the reciprocating carriage, the device for giving to it a slow forward motion, and a quick backward motion,

viz: the elliptical spur gears with their shafts, cranks, and connecting rods. Also, so arranging the two carriages and two saws, as that one shall serve as a check-balance or governor to the other, and vice-versa, by making the sum of the forces of the two saws when sawing to conform to that of one of them, when it alone is sawing, the compensation being effected by the comparative lengths of the kerfs that each or the single saw may be cutting."

123. For an *Improved Life-preserving Mattrass;* C. P. Crossman and E. M. Quimby, Warren, Massachusetts.

Claim.—"The spring and corks connected by the cords or straps, encompassed by the filling or layers, and enclosed by the case or covering provided with pockets and straps, the whole forming a new and useful article of manufacture."

124. For an *Improved Public Clock;* Aaron D. Crane, Boston, Massachusetts.

Claim.—"1st, Winding up and renewing the motive power at regular intervals for keeping the pendulum in motion, so as to supersede the necessity of winding up by hand, and so as to drive the pendulum independently of the other movements of the clock, by the arrangement of devices herein described, or their equivalents. 2d, Winding up the cord and weight that drives the pendulum, by means of the drop lever catch, or its equivalent, operating by its downward movement upon the hooked arm, and thereby turning the drum upon which the cord is wound. 3d, The arrangement of devices for winding up every hour the cord and weight, whereby the hands are kept in motion, in combination with the drop lever catch, whereby the escapements are operated in such manner as to give an intermittent rotary motion to the wheel for carrying the hands and prevent its moving more than one tooth at a time. And, in combination with the foregoing, the means employed for carrying the hour hand, the same consisting of the notched or toothed wheel, moving eccentrically and imparting the necessary motion to the wheel."

125. For an *Improvement in Rocking Chairs;* Thomas W. Currier, Lawrence, Mass.

Claim.—"The mode of combining rockers with the chair stand and the recumbent back, viz: by levers and arms, arranged and connected with the back, the arm rests, and the chair stand, and jointed to the rockers, so as to enable a person by laying hold of, and moving the back, either to cause the chair to be supported on its legs or on its rockers, as occasion may require."

126. For an *Improved Field Fence;* John Drown, Huron, New York.

Claim.—"The combination of the wedging clamps and chairs with the perpendicular tension wires or rods, arranged and operating together."

127. For an *Improved Device for Holding Horse Reins;* J. A. and F. Dunworth, Dobbs' Ferry, Virginia.

Claim.—"The elastic tubes, or their equivalents, placed within a case attached to the dash-board, the reins being attached to the tubes."

128. For an *Improved Trap for Catching Rats, and other Animals;* Earl D. Fink, Columbus, Ohio.

Claim.—"The pivot catch, with arms, with square and beveled slots or catches for supporting and disengaging the floors."

129. For *Improved Surveyors' Protractors;* John A. Finn, Simpson Co., Kentucky.

Claim.—"The forming of two concave protractors, and combining them with a convex protractor, square and scale of admeasurement, so as to form one instrument, by which plotting of every description may be done with greater facility, and equal if not superior accuracy."

130. For an *Improvement in Tree Protectors;* Josiah Foster, Sandwich, Mass.

Claim.—"Arranging the trough around the tree, so that there may be a clear space for the passage of insects or worms between it and the tree, and suspending the said trough from the body of the tree, by means of an elastic cover of cloth, or other suitable materials, extending around and affixed at its upper edge or part to the trunk of the tree, and at its lower edge to the trough. Also, in connexion with a flexible cover applied to the trunk of the tree, as described, making the circumventing trough in two or more sections or separate troughs, so jointed or applied together at their abutting ends, as to be capable of being tipped so as to enable their contents to be discharged."

131. For an *Improved Fire-box and Grate;* Jacob J. Folts, Buffalo, New York.

Claim.—"A revolving or turning fire-box, which is open at its opposite sides or ends, when used in combination with a fixed grate."

132. For an *Improved Method of Securing the Plane Iron to its Stock;* P. A. Gladwin, Boston, Massachusetts.

Claim.—"The two plates, D F, constructed as shown, viz: the plate D, being provided with the foot-pieces or projections and the oval opening, and the plate F, provided with the bit, and pivoted to the part of the throat, so that the bit may work within the oval opening of plate D."

133. For an *Improvement in Cutters for Harvesters;* John Gore, Fredonia, N. York.

Claim.—"The cutter as constructed, with the conical truncated pivot near its end, and oblong aperture near its centre, in combination with the cutter, when secured on bar, and fingers, by dove-tails and set-screw."

134. For an *Improvement in Railroad Snow Ploughs;* Henry T. Hartman, Lexington, Virginia.

Claim.—"The combination of the inclined clearer with the double inclined bottom of the car."

135. For an *Improvement in Window Frames;* Sebastian Haas, Buffalo, New York.

"This invention relates to the plan of constructing the frame, and the adaptation and operation of the sash therein."

Claim.—"The arrangement of the grooves in the frame, and the operation of the sash therein."

136. For an *Improved Harpoon and Lance;* H. W. Harkness, Bristol, Connecticut.

"This invention consists in so arranging a lance between two barbed spears, as that when it is thrown and is made fast in the fish or whale, by the tension of the boat line, the lever relaxes its hold of the collar on the lance rod, and by the continual tension of the boat line and the resistance of the fish or whale, the lance is caused to penetrate to the vitals."

Claim.—"The arrangement of the barbed spears, lance, rod, lever, and line."

137. For an *Improvement in Tools for Clenching Nails;* Darius J. Hendrickson, Otego, New York.

Claim.—"The construction of the lips or jaws of pliers, for the purpose of clenching the nails with which the shoes are fastened to the feet of horses and cattle, the clenching being done without a hammer or pounding, as heretofore."

138. For an *Improvement in Revolving Harrows;* W. A. Horrall and R. G. Sirwell, Grayville, Illinois.

Claim.—"The employment or use of three horizontal rotary toothed wheels, arranged as shown, viz: the back wheel having a permanent axis, and the two front wheels being rendered capable of lateral adjustment, so that the width of the harrow may be increased or diminished as desired, and the space or width of the ground included between the outer edges of wheels perfectly pulverized. Also, the elastic bars, provided with pressure rollers, and bearing on their respective wheels."

139. For an *Improvement in Brick Machines;* George O. Houck and Henry Gore, Springfield, Ohio.

Claim.—"1st, The boxes or followers, applied to or fitted on the ends of the frame, and connected thereto. 2d, The hinged plates or shelves which receive the moulds attached to the frame, and used in connexion with the stationary frames and sliding frames, provided with the wires. 3d, The sliding frames provided with the wires, or their equivalents, and connected with the springs, in connexion with the spring catches—the above parts being arranged so as to be operated automatically from the reciprocating follower frame. 4th, The strips or ledges placed within the box."

140. For an *Improvement in Reaping and Mowing Machines;* Charles Howell, Cleveland, Ohio.

Claim.—"The method of connecting the caster truck with the main frame, when used in connexion with a lever and arm, whereby the operator is enabled instantly to

raise the cutting apparatus to surmount such obstacles as may suddenly present themselves, and to regulate the height of the cut, and at the same time allow the machine to accommodate itself to the inequalities of the ground."

141. For an *Improvement in Water-backs for Ranges;* James Ingram, City of New York.

Claim.—"Arranging the water-back, and parts connected with and supporting the same, so as to allow the said back to be moved away from the fire, or be brought in contact with the same, without disturbing the pipes and connexions—and, in combination with said movable water-back, the lever and weight, to move the intervening soap-stone or fire brick."

142. For an *Improved Caster for Furniture;* Jacob Kinzer, Pittsburgh, Pennsylvania.

Claim.—"The improved mode of constructing casters for furniture (having the shank and its body cast in one piece, and the roller and its pivot in another), by making in each arm of the shank a deep recess, with a collar above and a wedge-shaped entrance from beneath, for the purpose of receiving the axis or pin of the roller, the recess to hold the roller in place when there is no weight upon it, and the collar to serve as a bearing for the journals of the axis to sustain the weight it has to support."

143. For an *Improvement in Knitting Machines;* Joseph K. and Edward E. Kilbourn, Norfolk, Connecticut.

Claim.—"Combining the needles and sinkers with a reciprocating carriage. Also, the adjustment of the position of the needles at the time the sinkers are forming the folds of yarn, by means of grooves in the noosing, whose sides converge, so as to ensure the uniform width of the stitches; also, the combination of a reciprocating series of needles with a reciprocating thread guide, operating so as to move at times with the needles, and to remain stationary at other times when the needles are moving. Also, the varying of the width of the fabric, by causing the thread guide to pass down between one pair of needles and to rise between another pair by mechanism, thus producing a selvage edge where widening is effected. Also, the combination of under supports, operating with a reciprocating series of needles, so as to support the needles and effect the closing of their barbs. Also, combining a reciprocating series of needles and sinkers, cam bars, or their equivalents, in such manner as to impart the necessary movements for forming the loops to the several members of the series in succession. Also, combining a reciprocating series of needles and sinkers with reciprocating mechanism, for taking up the work as it is formed."

144. For an *Improvement in Harness Trees;* F. B. Kuehnhold and D. B. Sturges, Newark, New Jersey.

Claim.—"The hook, in combination with the grooved nut and cross-bar, to form the concealed joint."

145. For an *Improvement in Extension Reach for Wagons;* J. W. Langdon, Marengo, Illinois.

Claim.—"The arrangement of the pawl, screw, pinion, and rack, whereby the reaches may be expanded, contracted, and locked at pleasure, and effective assistance given to the team when necessary by the driver."

146. For an *Improvement in Refrigerators;* W. D. Ludlow, City of New York.

Claim.—"The provision of an hermetically closed or sealed ice reservoir, within, or in connexion with, a vessel containing water or any other matter to be cooled or kept cool."

147. For an *Improved Hinge;* John C. Mason, New Hartford Centre, Connecticut.

Claim.—"The construction of a loose joint butt-hinge, which becomes a tight joint as soon as turned from the position in which it is put together, whereby I am enabled by putting hinges on each edge of a door to open it right or left, or by reversing the butt to make a solid hinge."

148. For an *Improvement in Water-closets;* Francis McGhan, Washington, D. C.

Claim.—"The chamber, behind valve, in adjustable communication with the water head, and having a waste discharge by the operation of the lever tilting the pan."

149. For an *Improved Ice Spur;* Charles Monnin, Buffalo, New York.

Claim.—"The curved or bow-shaped metallic plate, attached to the heel of the boot or shoe."

150. For an *Improvement in Harvesters;* Frederick Nishwitz, Brooklyn, New York.

Claim.—"The lever attached to the draft pole, and connected by the cord or chain to the front end of the frame, in connexion with the pawl, lever, and adjustable strap."

151. For an *Improved Raking Attachment for Harvesters;* James W. Patterson, Philadelphia, Pennsylvania.

Claim.—"The combination of the elevated or counter platform which receives the grain, and from which the rake receives and deposits it, with the rake as arranged, viz: with wheel, on which the outer end of the rake rides the incline plane or hinge rail, the weight or ball, and the chain."

152. For an *Improved Receiving Magnet;* Nathaniel Parks, Rome, New York.

Claim.—"Opening and closing the circuit by means of a vibrating permanent magnet, enclosed within one of the helices, together with an electro-magnet, and operated upon by both poles of the electro-magnet."

153. For an *Improvement in Railroad Car Wheels;* Stephen E. Parrish, Nashville, Tennessee.

Claim.—"A car wheel, made as described, viz: the hub and rim connected, by means of two plates having corresponding radial corrugations, said plates being cast with the hub and rim, and their several corrugations being united together so as to form a series of radial chambers within the wheel."

154. For an *Improvement in Cotton Presses;* H. W. Randle, Barnesville, Alabama.

Claim.—"The revolving box and follower mounted on a carriage, in combination with the sliding frame, so constructed as to lock the box and be withdrawn."

155. For an *Improved Fly-trap;* Thomas M. Scott, La Grange, Georgia.

Claim.—"The arrangement of the recess and spaces, chambers and piece, openings, receptacles, box, and partition, whereby the catching and retaining capacity of the contrivance is doubled, without any augmentation of the driving power, and with little or no increased expense in construction."

156. For an *Improved Method of Furling the Sails of Wind-wheels;* George W. Shaw, Thompson, Connecticut.

Claim.—"Attaching the sails to the frames, whereby the wind is allowed to pass between the sails and within the wheel, and to act against the sails as it passes out from the wheel. Further, attaching the upper ends of the sails to rollers, which have cords passing around them at one end, the ends being connected to a plate placed on the shaft and resting upon the spring, the above parts being used in connexion with the movable frame, whereby the area of the sails may be increased or diminished, as desired."

157. For a *Bank Check Canceler;* Wm. M. Simpson, Newark, New Jersey.

Claim.—"1st, The application and use of the canceling knives, in combination with an ordinary press, for the purpose of canceling checks and other instruments in writing. 2d, The use of the sectors operating between the knives through the disk by means of the pins, and in contact with the checks below and the projecting edge of the barrel above. 3d, The combination together of the disk, the sectors, and pins, with the knives, piston, and barrel."

158. For an *Improvement in Lubricators;* W. K. Stevens, Alexandria, Louisiana.

Claim.—"The arrangement of the disk and valves, when the latter operate and are rendered adjustable."

NOTE.—The above lubricator is constructed with a cylindrical oil chamber fitted with two segmental valves attached to a spindle, by means of tongues and notches, and held out against their seats by springs."

159. For an *Improvement in Mill Bushes;* George Strause, Boonsborough, Maryland.

Claim.—"Providing the bush segments with shoulders, arranged, whereby all the segments are adjusted by moving either one of them, by means of a single set-screw. Also, beveling the upper end of the segments."

160. For an *Improvement in Repeating Fire Arms;* Charles C. Terrel, Shullsburgh, Wisconsin.

Claim.—"1st, The employment of a double sliding charge holder, having openings

through it, in combination with a breech screw arranged opposite the bore of the barrel, so that the said breech screw makes a complete chamber of either opening which is in line with the barrel, and at the same time makes a tight joint between the chamber and barrel, while the other opening is in condition to receive a cartridge through its rear from a magazine in the stock of the gun, and easily detached. 2d, In combination with the use of two magazines, combining the double sliding charge holder and the hammer with the lever under the stock, by means of the bevel gearing and the eccentric pin and wrist-pin, so that by moving the lever in either direction the charge holder has imparted to it the necessary movement to receive a new cartridge from one of the magazines, and present another cartridge in line with the barrel, and the hammer is cocked, thus enabling the gun to be fired twice with one movement of the lever back and forth. 3d, Combining the hammer with the breech screw, so that the cocking and letting off of the former will draw back and drive up the latter by means of the fork, the slide, with its finger, and the spiral groove in the head of breech screw."

161. For an *Improvement in Ploughs;* Marshall Turley, Galesburgh, Illinois.

Claim.—"1st, The combination of the beams, plough shank, lever, and brace or adjusting rod, arranged behind the axle. 2d, The combination of the wheel for holding, with the cutter for cutting the stalks. 3d, The combination of the weed gatherer, with the plough or ploughs."

162. For an *Improved Churn;* Charles M. Vail, Susquehanna Depot, Pennsylvania.

Claim.—"The use of the graduated levers in connexion with the governor, the whole operating on the dasher staff through the director, keeping it in a vertical position, and avoiding friction."

163. For an *Improved Ironing Table;* W. Vandenburg and James Harvey, City of New York.

Claim.—"An ironing table composed of a stand of suitable form, having the board hinged or pivoted to it at one end, and a suitable support for the same at the other, with a spring, or its equivalent, applied to raise the board from its support."

164. For an *Improvement in Ploughs;* W. W. Van Loan, Catskill, New York.

Claim.—"The attachment of one or more horizontal cutters to the land-side of the plough, whereby the land is cut horizontally below the surface, so that it may be turned over by the mould-board during the succeeding cut with greater ease."

165. For an *Improved Gravimotometer;* J. W. Wetmore, Erie, Pennsylvania.

Claim.—"The new use of magnetic induction to form a gravimotometer, by means of the magnets on the equator of the globe, A, so that when the globe, A, is revolved on a vertical axis, it will cause the iron globe, B, to revolve in an orbit about A, and also its vertical axis. Also, the machine described as an improved orrery, because the revolutions correspond in cause and directions with the actual revolutions of the planets."

166. For an *Improvement in Raking Attachments for Harvesters;* Jacob U. A. and Andrew Wemple, Chicago, Illinois.

Claim.—"The peculiarly formed double crank arm, connected at opposite extremities with the rake and pitman, and journaled in a swivel box, in combination with the double-jointed pitman and the studs on the box."

167. For an *Improvement in Drawing Cotton, &c;* Cullen Whipple, Providence, Rhode Island.

Claim.—"The method of drawing cotton, wool, flax, or other fibrous material, viz: by means of a revolving toothed or card clothed cylinder, and a single pair of drawing rollers, which draw the fibres directly from the teeth of said cylinder, the surfaces of said rollers revolving as much faster than the surface of cylinders as is requisite to produce the desired degree of drawing."

168. For an *Improved Rest Attachment for Lathes;* Daniel White, Jr., Lowell, Mass.

Claim.—"The hinged index rest, for the purpose of roughing the material to be turned in connexion with its subsequent use."

169. For an *Improvement in Carriage Spring Guard;* Thomas Winans, Baltimore, Maryland.

Claim.—"The combination of the spring with the guard, arranged in relation to the spring, the body, and the bolster, or axle of the carriage."

170. For an *Improvement in Railroad Safety Switches;* Joseph Wood, Jersey City, New Jersey.

Claim.—"The combination of the safety rails, the forked rails, and the guard rails."

171. For an *Improved Hydraulic Valve;* Calvin and George M. Woodward, City of New York.

Claim.—"The arrangement and combination of the valves, caps, and bolts, the caps serving the extra purpose of bearings for the valves, and the bolts the double purpose of packing the caps and stopping the valves."

172. For an *Improvement in Cotton Presses;* F. W. Witting, Yorktown, Texas.

Claim.—"The peculiar means employed whereby the two movements are produced by one and the same application of power, to wit: having the side connected to the toggles formed of the levers in which the bars are attached, the bars being provided with projections arranged relatively with the follower, which is operated by the screw, or its equivalent."

173. For an *Improved Steam Pressure Gauge;* Wm. Burnett, Assignor to Seth Adams, Boston, Massachusetts.

Claim.—"The use in a pressure gauge of a straight flattened elastic tube, in combination with suitable mechanism for communicating the motion of the flattened sides of the tube, caused by pressure applied to its surfaces, to a suitable indicating apparatus."

174. For an *Improvement in Ploughs;* Elijah Bloodworth, Thomaston, Georgia.

Claim.—"The combination of beam and its handles with the double feet and braces."

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175. For an *Improved Apple Corer;* A. N. Alcott, Gowanda, New York.

Claim.—"The combination of the knife with the shaft and collar, or its equivalent, by which the knife may be thrown out from the shaft to cut out the core in its largest part."

176. For an *Improvement in Cable Stoppers;* Wm. H. Bridge, Boston, Massachusetts.

Claim.—"The cable tongs, with the levers, prongs, and clasp."

177. For an *Improvement in Seed Planters;* L. A. Butts, Cuba, New York.

Claim.—"The arrangement of the hoes, rods, shafts, plungers, and connecting rods."

178. For *Improvements in the Method of Manufacturing Furniture;* John H. Belter, City of New York.

Claim.—"1st, The method of accurately finishing at one operation a suitable stave for each layer of the spherical work, viz: the applying together of as many of the roughly manufactured staves as there are to be layers in the work, and bending the whole between clamps of the form and bevel required, and removing the superfluous material by a plane, or its equivalent. 2d, The applying together of the edges of the staves of the several layers at one operation, by confining the staves in their proper positions at one or more points, and completing the remainder of the edges to guide each other, as the cawls are compressed. 3d, The method of accurately breaking the joints of the several layers of staves, by notching the ends of the staves of each layer differently from the staves of the other layers, and resting the notches of all the staves across knife edges projecting perpendicularly from the surface of the inside cawl."

179. For an *Improved Dove-tailing Tool;* G. W. Billings, Cleveland, Ohio.

Claim.—"The dove-tailing tool, having semicircular lips, for the purpose of cutting tenons to fit mortises made by simply boring with a common auger or bit."

180. For an *Improved Stone-dressing Machine;* Elijah Brady, City of New York.

Claim.—"The arrangement and combination of the two adjustable platforms, with the self-adjusting tool stocks."

181. For an *Improvement in the Wheel and Axle Attachment of Horse Powers, &c.;* G. E. Burt and G. F. Wright, Harvard, Massachusetts.

Claim.—"The method by which the coupling pin is held in its proper place by the flanch on the thimble, in combination with the bolt, the thimble, the wheel, and the link."

182. For an *Improvement in Sewing Machines;* D. W. Clark, Bridgeport, Conn.

Claim.—"1st, The employment of the device which feeds the cloth, to flatten, hold, and place the loop in proper position for receiving the needle. 2d, Flattening and holding the loop, by means of a slide."

183. For an *Improvement in Spring Bed Bottoms;* Jacob Coover, Chambersburgh, Pennsylvania.

Claim.—"Constructing the lower slats with joints at or near the centre, by means of plate and hinges, and the screw passing through plates, for raising and lowering the slats."

184. For an *Improvement in Harvesters;* George S. Curtis, Chicago, Illinois.

Claim.—"The stirrup for vibrating the cutter bar, when made of circular form at, and with, two prongs or bearings at its upper end, two side bearings, and an extension; and when said stirrup is arranged astride the zig-zag cam, and to vibrate laterally on a pivot of a curved overhanging standard, and operating in relation to, and in combination with, the slotted blocks."

185. For an *Improvement in Shovel Ploughs;* Paul Dennis, Bemis' Heights, N. Y.

Claim.—"The bar and mould-board, in combination with the adjustable roller."

186. For an *Improvement in Cotton Presses;* Eugene Duchamp, St. Martinsville, Louisiana.

Claim.—"The arrangement and combination of the link, levers, straps, and plungers."

187. For an *Improved Water Metre;* W. M. Faris, Wheeling, Virginia.

Claim.—"The employment of two vessels, in combination with horizontal discharge pipes and a registering device, whereby nearly an accurate registration of the quantity of water discharged may be effected with a uniform or ununiform pressure of the head or source."

188. For an *Improvement in Cotton Gins;* T. C. Garlington, Lafayette, Alabama.

Claim.—"Grooving the roller, transversely above each saw, and obliquely across the said transverse grooves, when used in combination with ribs which diminish the protrusion of the saws gradually."

189. For an *Improved Expanding Tool;* James Greenhalgh, Jr., Burville, R. I.

Claim.—"The arrangement of the two truncated cone-shaped nuts, right and left screw, expansion pieces, and springs."

190. For an *Improvement in Cotton Gins;* B. D. Gullett, Aberdeen, Mississippi.

Claim.—"1st, The combination of the comb brush, the gin brush, and the gin—the brush being arranged between the comb brush and the gin brush. 2d, The lower carding brush, in combination with the gin brush and comb brush. 3d, The blast board, in combination with the gin, the gin brush, and the carding brush. 4th, The end brushes. 5th, The curved guards, in combination with the lower carding brush and stripper."

191. For a *Substitute for Infants' Diapers;* J. H. Hall, Kittanning, Pennsylvania.

Claim.—"The combination of a cushion, bag or receptacle, and cloth."

192. For an *Improvement in Horse Rakes;* Wm. Horning, New Lebanon, Ohio.

Claim.—"The arrangement of the seat, standards, and levers, or substantially equivalent devices, in combination with the rake."

193. For an *Improvement in Culinary Ladle;* Joseph C. Haines, Dublin, Indiana.

Claim.—"The ladle and strainer, adapted to operate in conjunction."

194. For an *Improvement in Cider Mills;* M. W. Helton, Bloomington, Indiana.

Claim.—"The arrangement and combination of the yielding stopper, taper screw, toothed cylinder, and case."

195. For an *Improvement in Harvesters;* Charles Howell, Cleveland, Ohio.

Claim.—"The revolving seat."

"This seat consists of a strong arm bent at an angle to the upper side of the rails, and so secured to them by a screw bolt, or other equivalent device, that it is capable of being turned in any direction."

196. For an *Improvement in Seeding Machines;* G. W. Hildreth, Lockport, N. York.

Claim.—"The combination and arrangement of the bar, levers, horizontal feet, and set-screw, with the cylindrical seed distributors."

197. For an *Improvement in Journal-boxes;* D. A. Hopkins, Paterson, New Jersey.

Claim.—"1st, Providing the housing with a diaphragm to prevent or nearly destroy the formation of currents of air, caused by the end play of the axle into, and out of, the housing. 2d, The combination of a boss, or its equivalent, upon the axle, with its location inside of the housing, and the feeding of the oil only to that portion of the axle not between the packing and the boss, said boss being formed by turning a recess in the axle, or by any other convenient means. 3d, Combining with the housing a movable stuffing-box, which surrounds the journal, and may be moved with it, without opening a passage for air or dust into the housing. 4th, The combination of the backing with the bearing brass."

198. For an *Improvement in Straw Cutters;* W. O. Hickok, Harrisburgh, Penna.

Claim.—"1st, The reciprocating serrated plate, in combination with knives. 2d, The toothed crushing cylinders rotating with different speed, in combination with the plate and knives."

199. For an *Improvement in Snow Ploughs;* Franklin L. Knapp, Gosport, N. Y.

Claim.—"The combination of the inclined platform, provided with perpendicular knives, horizontal knives, and ploughs, with the sliding gates and their corresponding doors, said slide gates being operated by means of lever, wheels, and shaft, all being so arranged and operated that the snow may be cut and all thrown off, either on one side or the other of the machine, or at different depths, and at different distances and at different quantities, on either side of the machine, that the nature of the case may require."

200. For an *Improvement in Steam Ploughs;* Peirce Klingle, Linnaen Hill, D. C.

Claim.—"The combination of the driving-wheels and ploughs, with the steering wheels."

201. For an *Improvement in Pickers for Looms;* Zebulon Lyford, Lowell, Mass.

Claim.—"Retaining or confining the picker material, by means of the curb, or its equivalent, to prevent wear and destruction by the picks or blows of the shuttle."

202. For an *Improvement in Machines for Splitting Coal;* John H. Lyon, Baltimore, Maryland.

Claim.—"The arrangement for joint operation of the spiked endless belt, and the picks driven by percussion."

203. For an *Improvement in Machines for Gathering Stones;* James H. Maydole, Eaton, New York.

Claim.—"1st, So constructing the scoops and arranging them in reference to, and in combination with, the other parts, that they will strike the earth and stones directly endwise in passing over the apron, and as they rise be turned or rotated to retain the stones. 2d, So constructing the fingers of the scoops, and so arranging them in connexion with those of the apron, that they shall cover the fingers of the apron instead of the spaces between them. 3d, The combined adjustment of the carriage and of the scoops upon it, by which the apron and scoops may be maintained at different angles at the same height, or at the same angle at different heights from or in the ground, or both varied at pleasure."

204. For an *Improvement in Machines for Sowing Fertilizers;* Wm. H. May, Alexandria, and Charles W. Coontz, Winchester, Virginia.

Claim.—"The combination of a metal ferrule or thimble, wooden shaft, and metal stirring arms, when said ferrule is arranged on the lower end of the shaft, and the stirring arms furnished with a screw-thread, and connected with, and fastened to, the thimble and shaft."

205. For an *Improvement in Table Refrigerators;* Charles A. McEvoy, Richmond, Virginia.

Claim.—"A combined ice dish and cover-cooler, constructed with the tubes or outlets in connexion with the ice pan, an annular space, and having the apertures in the external casing."

206. For an *Improvement in the Construction of the Permanent Way of Railroads;* James Edward McConnell, Wolverton, and Wm. Seaton, Chester Place, Regents' Park, England; patented in England, June 24, 1852.

Claim.—"The system or mode of constructing the permanent way of railways, consisting in the use of right-angled triangular longitudinal sleepers and cross-ties, in combination with wrought iron rails."

207. For an *Improved Device for Connecting the Panels of Field Fences,* Rensselaer Merrill, Elmira, New York.

Claim.—"The combination and arrangement of the alternate anchored or fixed panels with the movable panels, when the same are constructed by means of the hooked or recessed locking joints and keys."

208. For an *Improvement in Railroad Car Springs;* Stephen Morse, Springfield, Massachusetts.

Claim.—"The combination of the metallic cups fitting into each other, filled with pieces or parts of india rubber which has been used, and in a measure worn out, when mixed with sponge, cork, or cotton, or any other substance, which under compression will prevent the india rubber from solidifying. Also, casting one of the cups in the recess of the jaw, in order to strengthen it, while at the same time the cup thus cast forms a part of the spring."

209. For *Improved Fire-Tongs;* Daniel Moore, Brooklyn, New York.

Claim.—"The slide and tongue attached to the respective sides of the legs of the tongs."

210. For an *Improvement in Cotton Bale Hoops;* John McMurtry, Lexington, Ky.

Claim.—"1st, Splitting one end of a cotton bale hoop, so that it may be contracted or expanded in width as may be required, in order to effect the locking of the hoop round the bale without slack. 2d, The combination of the split and shouldered end of the cotton bale hoop with the slotted end."

211. For an *Improvement in Cotton Seed Planters;* Daniel B. Neal, Mount Gilead, Ohio.

Claim.—"The arrangement of the adjustable bottoms with the sliding cover and cylinders."

212. For an *Improvement in Sewing Machines;* Abner N. Newton, Richmond, Ind.

Claim.—"1st, The slotted lever, in combination with mortise lever. 2d, The combination of levers with the needle bar."

213. For an *Improvement in Railroad Track Clearers;* Pelatiah Osgood, Waterville, Maine.

Claim.—"The mode of supporting each scraper, viz: by a chain, or its equivalent, the swinging bar, B, or, B′, and the horizontal bar or bars thereof, connected with the frame. Also, combining with each scraper supporter a balancing spring, or equivalent, and a pressure spring. Also, the particular mode of making each scraper, viz: with a cleaning notch at its heel, and a riding curve at its toe or inner end. Also, applying the wing bars of the scrapers to their supporting bars, that the former may have a lateral swing or play, and connecting the two swing bars, as specified, viz: by a rod and spring, or equivalent devices, the whole being in order that the scrapers while being drawn over the track may be preserved in close contact with the inner edges of its rails and pass obstructions, however the distance between the rails may vary."

214. For an *Improvement in Grain Mills;* Philander Perry, Troy, New York.

Claim.—"1st, The arranging two eccentric plates or disks upon one shaft, both plates revolving in opposite directions. 2d, The arranging an eccentric cone upon an eccentric and revolving plate, in connexion with the crackers placed within the concave surface of the convex receiver. 3d, The manner of arranging the gearing upon the fly-wheel and the eccentric plate. 4th, The arranging a stationary hopper on an eccentric and revolving plate."

215. For an *Improvement in Harvesters;* H. A. Parkhurst, Fairfield, New York.

Claim.—"1st, Connecting the finger bar to the main frame, by means of the intermediate frame, the same being hinged to the front and rear cross-timbers of the main

frame, in a line (or nearly so,) with the crank-shaft, for the purpose of relieving the drag of the finger bar upon the ground, and allowing it to conform to uneven surfaces, without varying the throw of the cutters through the guards. 2d, The arrangement of the mechanism for the purpose of raising and lowering the main frame of the machine. 3d, Making the finger bar in the 'ogee' form, so that the base of the guards may be placed upon, and fastened to, the upper side thereof, and at the same time support the cutter bar in rear of the front curve of the finger bar."

216. For an *Improved Rotary Valve;* Thomas Richards, Plattsburgh, New York.

Claim.—"In combination with a continuously rotating valve plate having the four cavities and closed spaces between them, the ports or passages, which communicate respectively with opposite ends of the cylinder, and the steam and exhaust ports or passages crossing each other at the centre of the valve."

217. For an *Improved Stave Machine;* Wm. Robinson, Augusta, Georgia.

Claim.—"The self-adjusting bar and cap-piece, in combination with the knives. Also, the combination of the expanding guide plates with the rotary cutters. Also, the longitudinal piece, spring dog, pressure roller, and stationary cutter, in combination with each other and the rotary cutters."

218. For an *Improvement in Railroad Car Wheels;* Seymour Rogers, Pittsburgh, Pennsylvania.

Claim.—"So constructing a railroad car wheel that the rim thereof may revolve independent of the hub, when required. Further, inserting a spring or springs therein."

219. For an *Improvement in Boxes for Receiving Money in Carriages, &c.;* James Rodgers, City of New York.

Claim.—"The movable glass slide to the receptacle or hopper, kept at the bottom of the fixed glass, by springs, or their equivalents. Also, connecting the cover of the money receptacle to a bell, for the purpose of attracting the driver's attention when money is placed in said receptacle. Also, in combination with said bell, connected to the cover of the money receptacle, the slide and dog, to call the attention of passengers to the payment of their fares."

220. For an *Improvement in Harvesters;* Charles Roberts, Livonia, New York.

Claim.—"The arrangement and combination of the peculiarly curved teeth, concave, elevator, separator, and elevator."

221. For an *Improvement in Railroad Car Springs;* David B. Rogers, Pittsburgh, Pa.

Claim.—"1st, The forming a spring of a square plate of thin steel, by bending the four corners in one direction, or two corners in one direction, and the other two in an opposite direction. 2d, The forming of a spring of one piece of thin plate steel, with antagonistic bearings, by which is obtained a central equilibrium in or between a succession of squares."

222. For an *Improvement in Wardrobe Bedsteads;* Chandler Robbins, Chicago, Ill.

Claim.—"The arrangement of the attachment of the sacking to the bar, with the strap for holding the bed and clothes in position."

223. For an *Improvement in Volute Springs;* Daniel G. Rollin, City of New York.

Claim.—"A volute spring having the form of two volutes rigidly connected, so as to form a single spring."

224. For an *Improvement in the Fastening of Cast Iron Bedsteads;* A. C. Semple, City of New York.

Claim.—"Fastening the corners of bedsteads, and other similar furniture, by the mitre joints and the projections on the rails or sides, and the projections on the legs or supports catching behind them, by which the parts form their own fastening, and mutually support each other."

225. For an *Improved Spike Machine;* Leander Shearer, Duncannon, Pennsylvania.

Claim.—"The application of the cutter acting against the cutting edge of the feed rest, and the dies operating in combination with the reciprocating carriage, vibrating lever, and header lever, with its header."

226. For an *Improvement in Saw-Mills;* Charles Strong, Hartford, Vermont.

Claim.—"The arrangement of the working levers, axis, oscillating pendant, bracket lever, hinged to levers and to braces, and stirrups, counter lever, straining rods, and rockers combined."

227. For an *Improvement in Ploughs;* Turney Sanford, Redding Ridge, Connecticut.

Claim.—"The bars in connexion with the metallic rods and braces, the whole being constructed and arranged relatively with each other and the standard, land-side, and mould-board."

228. For an *Improvement in Seed Planters;* Daniel L. Tilton, Mt. Carmel, Illinois.

Claim.—"The arrangement of the vibrating block, adjustable bracket, with or with out the valve, in combination with the hopper."

229. For an *Improvement in Garden Tools;* Hartwich Von Unwerth, Salem, Mass.

Claim.—"The combination of the weeder, trowel, and dibble."

230. For an *Improvement in Corn Huskers;* L. F. Ward, Marathon, New York.

Claim.—"The belt armed with teeth, in combination with stationary prongs, which catch and hold the husks, and yield to let the ears of corn pass or be carried forward by the belt and teeth, so as to separate the corn from the husks. And in combination with the belt armed as above described, the wires to clear the husks from the underside of the ears of corn. Also, the wires or prongs, or their equivalents, to clear the husks from the teeth on the belt. Also, the arches, in combination with the rotating knives for severing the butt-stalk from the ears of corn."

231. For an *Improvement in White-wash Brush Blocks;* Charles Williams, Philadelphia, Pennsylvania.

Claim.—"1st, The permanent rests or gauges, and in combination with the same, the slitted and serrated tongue. 2d, Covering the blade with serrated metal. 3d, The forming part of, and intersecting with, each tie-hole."

232. For an *Improved Method of Lighting Gas by Electro-galvanic Batteries;* Archelaus Wilson, Boston, Massachusetts.

Claim.—"Combining with gas or other burners a vibrating electric conductor, so that after producing ignition, the conductor shall be removed from the flame. Also, the employment of the motive power of an electro-magnet with the combined vibrating electro-conductor and burner."

233. For an *Improved Shoe Peg Machine;* Abijah Woodward, Keene, N. H.

Claim.—"Giving an uniform and arbitrary intermittent rotary motion to the fluted feed roller, whatever may be its adjustment, by means of two bevel wheels, peculiar screw cam, worm wheels, and pinions, arranged as follows:—one of the bevel wheels being on the upper end of a vertical shaft, and the other—which must always gear with the first—being on the end of the fluted roller, and both being adjustable so as to suit different thicknesses of peg blocks, without getting out of gear with one another, and with the driving-shaft, the cam being so constructed, and its screw thread arranged in such relation to the eccentric pin which moves the splitting knife, that the feed or movement of the block will always cease or be complete before the knife commences to descend, and again commence just as the knife has completed its ascent."

234. For an *Improvement in Straw Cutters;* Thomas H. and Daniel T. Willson, Harrisburgh, Pennsylvania.

Claim.—"1st, The arrangement of the axis of the driving pinions to the yielding feed roller above the axis of said roller, when said yielding feed roller vibrates in vertical guides. 2d, Constructing the feeding trough with inclined openings in its bottom, in order to facilitate the passage of the dirt, and prevent the short pieces of fodder from escaping. 3d, Constructing the lower feed roller with openings in its periphery for the escape of dirt, and other hard materials, which collect upon it during the passage of the fodder between the rollers. 4th, The combination of the longitudinal ribs on the lower feed roller with the openings in its periphery."

235. For an *Improvement in Harvesters;* Benjamin Yeakel, Allentown, Penna.

Claim.—"The combination of the finger, cutters, and guard."

236. For an *Improved Oscillating Steam Engine;* John S. Barden, New Haven, Connecticut, Assignor to self and Aaron W. Rockwood, Boston, Massachusetts.

Claim.—"Combining with the semi-cylindrical steam chest, and the yoke or bar, a small rocker bearing socket and spaces, arranged between, or with respect to, the valve chest and bar. Also, the arrangement of the induction and eduction chambers and their ports in the semi-cylindrical steam chest. Also, the application and arrangement of the two separate rotary cut-offs, within the induction chamber, and with respect to its two supports. Also, the combination of the mechanism for operating the two cut-offs, the same consisting of the secondary crank, the slotted rocker lever, the cranks, and the connexion bar, or its mechanical equivalent. Also, applying the wrist of the secondary crank to the wrist of the primary crank, so that the former may be adjustable with respect to the axis of the primary crank."

237. For an *Improved Carpet-beating Machine;* Joseph Harris, Jr., Roxbury, and Daniel Holmes, Chelsea, Mass., Assignors to Daniel Holmes, aforesaid.

Claim.—"1st, The use of the elastic whips connected together at their ends by the cord. 2d, Placing an elastic cushion in front of the carpet for the whips to strike on. 3d, The vibrating beaters for beating the opposite surface of the carpet."

238. For an *Improvement in the Construction and Arrangement of the Weighing Mechanism Applied to the Carts of Coal Dealers, and others;* John Hartman, Jr., Assignor to John Hartman, Sen., Philadelphia, Pennsylvania.

Claim.—"1st, Supporting the platform levers directly upon the axle-tree and the cross-piece, which is fixed to the thill timbers. 2d, The use of the friction rollers, so that their axles shall serve as the weight points to the levers, the same being applied to the levers to operate as set forth. Also, the combination of the vertically slotted plates, rigidly fixed to the axle-tree, and the thill pieces, with the friction rollers working in the said slots, and upon the journals fixed in the frame of the cart body, so as to operate together."

239. For an *Improved Scissors Sharpener;* George Hinman, Assignor to self and John H. Pardee, New Haven, Connecticut.

Claim.—"Making or producing a scissors sharpener as a new article of manufacture, when constructed and made to operate in either of the ways described."

"My improvement consists in so constructing the sharpener that the cutter and guide may be readily adjusted to any required angle, either by having the cutting blade moved and secured by a cam lever, or its equivalent, to adjust the angle with a stationary or fixed guide. Or by having the guide susceptible of being moved to adjust the angle, with a stationary or fixed cutting blade, for the purpose of suiting it to the bevel of the cutting edges of any kind of scissors or shears."

240. For an *Improvement in the Manner of Attaching Legs to Walking Locomotives;* Solomon G. Hoge, Assignor to self, R. H. St. John, Bellefontaine, and J. E. Leas, Dayton, Ohio.

Claim.—"The construction and arrangement of the sliding bars, with pendant hinged legs or perambulating devices, and the combination thereof with the connecting rods and the wheels."

241. For an *Improved Arrangement for Carrying Off Smoke from Locomotives in Engine Houses;* John O. D. Lilly, James L. Vanclain, and James W. Lilly, Lafayette, Indiana.

Claim.—"The construction and arrangement of the movable hood, or its equivalent, adapted to fit closely over the top of a locomotive funnel, when used in combination with connecting flues, stationary furnace, and stack."

242. For an *Improvement in Brick Machines;* Daniel Lombard, Assignor to self and George F. Richardson, Boston, Massachusetts.

Claim.—"Combining with the brick making machinery a means of heating the condensing roller. Also, the combination of the gauge, the scraper, and the condensing roller, with the hopper, the moulding wheel, and mixers."

243. For an *Improved Omnibus Fare-box;* Israel S. Reeves, Assignor to self and I. B. Slawson, New Orleans, Louisiana.

Claim.—"The glass plates as arranged in connexion with the sliding table."

244. For an *Improved Lathe for Cutting Tenons for Clock Movements;* Russel Peck, Bristol, Connecticut, Assignor to self and G. H. Wooster, City of New York.

Claim.—"The clamp formed by the bars, when arranged and combined with the mandrels and gauge."

245. For an *Improvement in Spring Bed Bottom;* Charles Schroeder, Assignor to self and P. H. Tuska, City of New York.

Claim.—"The spring bottom constructed as described."

"My invention is an improvement in that class of 'spring bottoms' in which series of transverse arches are constructed, each arch being a set of short spiral springs lying horizontally, and all of the springs in the set being formed from a continuous wire which is attached at both of its ends to, or rests upon, the frame."

246. For an *Improved Washing Machine;* Benjamin R. Smith, East Whiteland, Assignor to John Hellings, West Whiteland, Pennsylvania.

Claim.—"The combination of the guides and bearers with the seat of the queen post and the lever hook, for the shifting of the movable worker from its concave bed."

Additional Improvements.

1. For an *Improved Bullet Mould;* Henry L. De Zeng, Geneva, New York; patented March 31, 1857; additional dated Feb. 16, 1858.

Claim.—"1st, The plate with the permanent core, in combination with the jaws and the screw operating in the slot. 2d, The blade, in combination with the handle and the screws."

2. For an *Improvement in Life-preserving Berths for Steam and other Vessels;* Elbridge Foster, Hartford, Connecticut; patented Sept. 1, 1857; additional dated Feb. 16, 1858.

Claim.—"The addition of the adjustable inflated angular side air chambers to the inflated keel life-preserver berths."

3. For an *Improvement in Lime-kilns;* Powell Griscom and Charles S. Denn, Baltimore, Maryland; patented November 17, 1857; additional dated Feb. 23, 1858.

Claim.—"The combination of the transverse partition, with the oblong inverted pyrimidal basin, oblong stack, and enlarged draft flues, when said flues are used as auxiliary furnace doors."

Extension.

1. For an *Improvement in Straw Cutters;* H. M. Smith, Richmond, Virginia; patented February 20, 1844.

Claim.—"The combination of the guard with the curved knife and arm."

Re-Issues.

1. For an *Improvement in Scythe Fastenings;* Pinckney Frost, Springfield, Vermont; patented January 11, 1853; re-issued Feb. 9, 1858.

Claim.—"The combination of the loop-bolt and set-ring."

2. For an *Improvement in Corn Planters;* Martin Robbins, Cincinnati, Ohio; patented Feb. 10, 1857; re-issued Feb. 9, 1858.

Claim.—"1st, The method of discharging seed from a plough or drill, by means of the anchored chain, or its equivalent. 2d, The chain or cord adopted to operate the discharging mechanism of a seed planter. 3d, In combination with a suitable chain or cord, the arm, provided with a vibrating claw or tappet, or substantially equivalent devices, operating the seed-delivering mechanism."

3. For an *Improvement in Seed Planters;* George W. Brown, Galesburg, Illinois; patented August 2, 1853; re-issued Feb. 16, 1858.

Claim.—"A shoe for opening a furrow which has a convex edge in front, and a seeding tube in its rear end, so that it may cut through any grass, open out a furrow, and hold it open until the seeds are deposited in it."

4. For a *Walking-Stick Gun;* Ira Buckman, Jr., City of New York; patented August 4, 1857; re-issued Feb. 16, 1858.

Claim.—"1st, Moving the lock piston backwards to effect the cocking of the lock, by revolving the section and its attached spiral cam. 2d, Cocking the lock (or retaining the lock piston in position when moved backward to its full extent,) by the locking plate dropping into a transverse groove in the top of the piston. 3d, The construction and operation of the trigger, which enables the trigger to be closed up against the body of the gun while the lock is cocked. 4th, The combination of the locking plate with the trigger, by which the strain of the spring of the piston is brought entirely upon the lock ing plate, leaving the trigger free from strain or pressure, and enabling the trigger to discharge the lock with slight effort. 5th, The thimble, for the purpose of being moved over the lock catch and trigger to confine and secure them, so that the lock cannot be operated without first moving back the thimble. 6th, Extending the body beyond the end of the barrel, and constructing it of lighter material than the barrel, for the purpose of making the cane of requisite length, and of guiding and directing the course of the bullet after it is fired from the barrel, without adding materially to the weight of the implement."

5. For an *Improvement in Moulds for Casting Pencil Sharpeners;* Walter K. Foster, Bangor, Maine; patented April 17, 1855; re-issued Feb. 23, 1858.

Claim.—"In combination with the matrix for casting or forming the hollow conical or bell-shaped body of a pencil sharpener, a device or mechanism for holding the blade in the matrix, and one for forming the chip-throat of such blade and body, during the process of casting or founding the said body on the blade. And, in combination with a device or mechanism for holding the blade in the matrix, a slider or device for supporting its back while such blade is in contact with the core and the throat-slide or former. Also, making the core with a groove arranged on its outer surface, combining with the said core and the mechanism for holding the blade, a groove arranged in the core. Also, the mode of making the throat-slide or chip-mouth former in two parts or plates, applied respectively to the two parts or sections of the mould. Also, combining with the base, its core, and the parts of the mould, when applied to each other, and an adjustable gauge or stop arranged on the base plate, or in other respects so as to operate."

6. For an *Improvement in Printing Press;* George P. Gordon, City of New York; patented August 31, 1852; re-issued Feb. 23, 1858.

Claim.—"1st, The arrangement of a distributing cylinder or segment of a cylinder, or other suitable form of distributing surface, which shall always be held or fixed in the desired position, without resort to stops, latches, or other secondary and movable attachments, and at the same time allow the rollers, or sets of rollers, to move unimpeded in an onward direction around or over it, for the purpose of distributing the ink evenly, and meeting and inking the form of types in their transit, one set after the other, at each succeeding passing over the distributing surface and form of types, performing its proper duties, the whole being one continuous operation. 2d, Carrying two or more sets of rollers in an onward direction around and over a distributing surface or surfaces, and a type bed, when such sets of rollers shall admit an impression to be taken immediately after the passage of each set of rollers consecutively, whether the rollers are carried in the precise manner, or by some equivalent mechanical contrivance to produce a like result—that is to say, the allowing of several sets of rollers, alternately or consecutively, to pass over or around the distributing surface and the form of types, and admit an impression to be taken between the time one of the sets of rollers leaves the form and the next set arrives at it, for the purpose of giving a slow motion to the inking, with rapid impressions upon the same form of types, thus effecting more speed as regards the number of impressions in a given time. 3d, The arrangement of a fixture to the frame, and forming a part thereof, one on each side of the press, extending inwards towards its longitudinal centre of tubular projections, or studs, or staves, or shoulders, or their equivalents, for the purpose of supporting both the bed and inking apparatus, or either of them, upon such tubes or projections, while at the same time the frame or roller carriage may be snugly fitted to the outside of such tubes, so as to have its bearing and revolve upon it, and the projecting tubes form the journal boxes in which the main shaft rests, and revolves each of these by different gearing and at different speeds, if need be, so that by the use of such projecting studs, may be effected change of speed between the inking rollers and the impression shafts, all working upon and from one general centre. Also,

the separate revolving of the rollers upon the outside of the same, regardless of where the main shaft may be placed, studs forming supports for the inking and impression apparatus. 4th, The arrangement of the gauge guides, pawl, cranks, and rod, pin, and wheels, in combination with the shears for cutting off the sheet after it is printed, and the cam from which it receives its motion."

7. For an *Improvement in Safety Indicators for Steam Boilers;* Lucius J. Knowles, Warren, Massachusetts; patented Feb. 10, 1857; re-issued Feb. 23, 1858.

Claim.—"The arrangement of the vessels as applied and connected with the feed pumps and steam whistle, for the purpose of regulating the pump and sounding an alarm. Also, connecting the pipe with the boiler, by means of the feed pipe."

8. For an *Improvement in Billiard Cues;* Conrad Leicht, City of New York; patented May 27, 1856; re-issued Feb. 23, 1858.

Claim.—"My mode of providing cue tops or the cues with screws, and adjusting them to each other."

9. For an *Improvement in Carding Machines;* Stephen R. Parkhurst, City of New York; patented June 20, 1848; re-issued Feb. 23, 1858.

Claim.—"The application of the steel ring, toothed cylinder or cylinders, to act as combers, worker, or doffers, in combination with common wire tooth carding, for the purpose of quicker and more effectively opening wool and other fibrous materials."

DESIGNS.

1. For *Stove Plates;* Edward J. Delany and John Martino, Assignors to Cresson, Stuart & Peterson, Philadelphia, Pennsylvania; dated Feb. 16, 1858.

2. For *Handles of Spoons, &c.;* Henry Hebbard and John Polhamus, City of New York; dated Feb. 16, 1858.

3. For *Tables for Sewing Machines;* S. F. Pratt, Roxbury, Massachusetts; dated Feb. 16, 1858.

4. For *Compass Stands;* E. A. Tuttle and Thomas Barry, City of New York; dated Feb. 23, 1858.

5. For *Tea and Coffee Pots;* Allen Leonard, Assignor to Rogers Brothers Manufacturing Co., Hartford, Connecticut; dated Feb. 23, 1858.

6. For *Stove Plates;* N. S. Vedder and Ezra Ripley, Assignors to Louis Potter, Troy, New York; dated Feb. 23, 1858.

The claims on the above, are for the several shapes, forms, ornaments, and configurations.

MECHANICS, PHYSICS, AND CHEMISTRY.

Translated for the Journal of the Franklin Institute.

Photography.—Second Memoir on a new Action of Light. By M. NIEPCE DE SAINT-VICTOR.

There are two ways of exhibiting the new action exerted by light upon the bodies struck by it. The first, that which I have described in my first memoir,* consists in exposing to the sun, or even to the diffused light of day, a design, an engraving for instance, which is then laid upon a sensitive paper prepared with chloride of silver. The second way, which I am about to describe, is still more conclusive.

Take a sheet of paper, which has heretofore remained in the dark; cover it with a photographic negative either on glass or on paper; expose it to the sun's rays for a time, longer or shorter according to the intensity of the light; bring it back into the darkness; remove the nega-

* See Journal of the Franklin Institute, page 50, of the present volume.

tive which covers it, and treat it with nitrate of silver; there will then be seen in a short time an image which may be fixed by well washing it in pure water.

If it is desired to procure an image more rapid in its development, and more luminous, the sheet of paper must be first impregnated with a substance which undergoes in a higher degree the luminous action referred to in the former memoir, a storing up (*emmagasinement*), if we may so express it, with a persistence of luminous activity. A very efficacious substance of this kind is an aqueous solution of the nitrate of uranium, obtained either by treating the oxide of uranium by dilute nitric acid, or by dissolving the crystals of the salt in water.

The sheet of paper should be so far impregnated with the uranium salt as to have a perceptible straw-yellow tint; it is to be dried and kept in the dark. When it is desired to experiment, it is covered with a negative, exposed to the sun for about a quarter of an hour, brought back to the dark, treated with nitrate of silver; and you will instantly see a very strong positive image appear, with the chestnut color of ordinary proofs; to fix it, it is sufficient to immerse it in pure water; the water dissolves all the salt of uranium, which, protected by the shadows of the negative, has not received the action of the light, and the image is fixed. If after having well rinsed the proof, it is desired to change it to black, you have but to treat it with the commercial solution of chloride of gold. The same result may be obtained in the following manner: immediately after the exposure to the light, pass the proof into a solution of bichloride of mercury; leave it there only a few moments, but rather longer or shorter, according to the time of exposure, which must be three times as long as in the former case; rinse it in pure water, and treat it with a solution of nitrate of silver, in which it is to be left until the image is entirely developed, with fine tones of ebony-black; then rinse it in pure water in order to fix it.

If after the insolation or exposure to the sun, a solution of chloride of gold is substituted for the developing solution of nitrate of silver, the image will be found to appear instantaneously of a very intense blue; it may also be fixed by washing in pure water.

Negatives may also be obtained by placing in the camera, a sheet of paper impregnated with nitrate of silver. But, in the present state of things, this process is very slow, and can only be used for taking views of buildings.

I have coated slips of card-board with a number of different substances, and have obtained very variable results. With some, the difference of the impression on the part which had been insolated and that which had not been, when both were treated with a solution of nitrate of silver, was very great; with others, the difference was scarcely sensible; and for some it is not at all appreciable; yet they are rapidly influenced by light.

In the first category I will cite: citric and oxalic acid, sulphate of alumina, citrate of iron, the iodides and bromides, arsenious acid, the neutral tartrate of potassa, lactic acid, and the animal skin, which participates in the properties of the salts of uranium, and of tartaric acid.

In the second category: the sulphate of quinine, the tinctures of net-

tles (*chlorophylle*), of the seeds of *datura stramonium*, and of *curcuma*, the infusion in cold water of the bark of horse-chestnuts (*esculine*), sugar, collodion, gelatine, and starch (*empois*).

I have, however, perfectly established, that the bodies which best preserve the activity given them by insolation, are, with the exception of the salts of uranium, those which are the least disposed to *fluorescence*.

In the third category: the chlorides, the acetate of morphine, and the phosphate of ammonia, which, under the developing action of nitrate of silver, gives very handsome black tones; prussic acid, the quinate of lime and morphine, which give chestnut-browns.

The experiments which I have described in this memoir show, I think, in the clearest manner, that light communicates to certain substances a real activity; or better, that certain bodies have the property of storing-up light in a state of persistent activity. The quantity of persisting activity is greater or less according to the nature of the substance, the longer or shorter duration of the exposure, the atmospheric circumstances, &c. It has its limits; that is, there is for each substance a maximum of activity, and when this has been obtained, prolonged insolation adds nothing to it.

A body made active by insolation, preserves its power of acting upon the salts of gold or silver, for more than a day in the dark and open air. It will finally lose that property, but it may be restored to it by a new insolation; provided always the substance has not been altered or modified in its chemical composition, as for instance, the iodides and bromides are.

The paper impregnated with the nitrate of uranium presents a remarkable property; it becomes colored under the influence of light; then in the dark discolors in a day or two, and then becomes re-colored; it reduces the salts of gold and silver whenever it is colored.

The persistent activity communicated to a body by light is exerted not only on the salts of gold and silver, but on several organic and inorganic bodies which light affects or modifies by its direct action. Thus, a body rendered active by insolation will transmit that activity by contact and in the dark to another body, tartaric acid for instance. The bichromate of potassa becomes, under the same influence, insoluble in water, as it would become by exposure to the sun; but the heliographic varnish made with bitumen of Judæa and guyac resin resist the persistent activity of paper impregnated with salts of uranium or tartaric acid, and insolated.

I propose to examine in subsequent experiments whether the persistent activity will determine the combination of chlorine and hydrogen; whether it can be acquired in a luminous vacuum, &c., &c.

An engraving moistened and insolated reproduces itself very well upon sensitive paper, but if it is covered by some millimetres of water, it is not reproduced, even in a solution of a salt of uranium or tartaric acid.

Gelatine mixed with a salt of uranium, and exposed to the light, becomes insoluble, as if it had been mixed with bichromate of potassa.

I have established this remarkable fact, that the lights of an engraving impregnated with a salt of uranium, or of tartaric acid, and insolated,

will impress themselves very well on sensitive paper prepared with chloride of silver, while the shades leave not the slightest trace of action.

The same is the case with a drawing with an aqueous ink, and a sheet of paper covered with lamp-black. It will be curious to study the action of the solar spectrum on a piece of card-board impregnated with tartaric acid, which is not fluorescent, or does not become luminous by exposure to the ultra-violet or invisible rays; which rays will, after insolation, impress their image most strongly, the more or less refrangible? Experiment must answer.

The photographic proofs which I have the honor to present to the Academy (of Sciences, of Paris), were made by M. Victor Plumier, a very skilful photographer; he succeeded at the first attempt, in the application of my new process for the impression of positives, which leads me to hope that this process may enter without trouble into practice, and will constitute a progress which has been greatly desired.

It would be perhaps gratifying, if in conclusion I should point out a mode for the reproduction of engravings, by means of the vapor of phosphorus, which, as I stated in my memoir published in 1847, have the property of collecting and condensing upon the shadows to the exclusion of the lights.

The engraving to be copied is exposed to the vapors of phosphorus burning slowly in the air, the shadows only absorb the vapors; a sheet of sensitive paper prepared with chloride of silver is applied; after a contact for a quarter of an hour, the engraving is imprinted upon the paper with phosphuret of silver, which, when strong enough, resists the action of dilute chemical agents. The best mode of operating, consists in placing the engraving in a box in front of a sheet of paste-board, covering one side of the box whose surface has been sufficiently rubbed with a stick of phosphorus, the paste-board must be re-rubbed for each operation; for if the phosphorus is red it produces no effect. A sheet of water of a centimetre (0·4 inch), or more in thickness, does not stop the deposition or action of the vapors of phosphorus. The action is exerted on the sensitive paper even through india-paper; that is to say, that if an engraving on india-paper is laid upon a sheet of sensitive paper, and these placed together in the box in face of the phosphorescent wall, a negative image of the engraving will be obtained, as if the shadows had behaved like a screen, and the lights had allowed the vapors to pass through and impress the sensitive paper. Only if the exposure be too long prolonged, the shadows will also impress their image, and this will even prevail over the ground. The vapor of sulphur produces analogous effects, and gives an image or reproduction of the engraving drawn in sulphuret of silver; but this image is not stable.—*Cosmos*, March, 1858, p. 268.

For the Journal of the Franklin Institute.

Experiments on the Form of Bellows Nozzles, made at the Smithsonian Institute, June, 1855. By Thomas Ewbank.

From the earliest times, the nozzles of blowing apparatus have been tapered towards the vent, for the purpose of concentrating the blast. Are there circumstances under which a different form may be usefully

adopted, and one by which *more* air may be discharged from the nozzle *than issues from the bellows?* These experiments were designed to ascertain whether the apparent impossibility were not a fact.

The apparatus (fig. 1,) was prepared. A gas holder, A, having the inverted vessel 13 inches diameter and 28 deep, properly balanced. A small forge bellows, B, worked by a weight on the end of the lever or rockstaff, was so arranged that the nozzles to be tried could be slipped over the ordinary one, and at the same time communicate with the gas holder through the pipe, C. A scale was attached to the gas holder by which the rise and fall was measured.

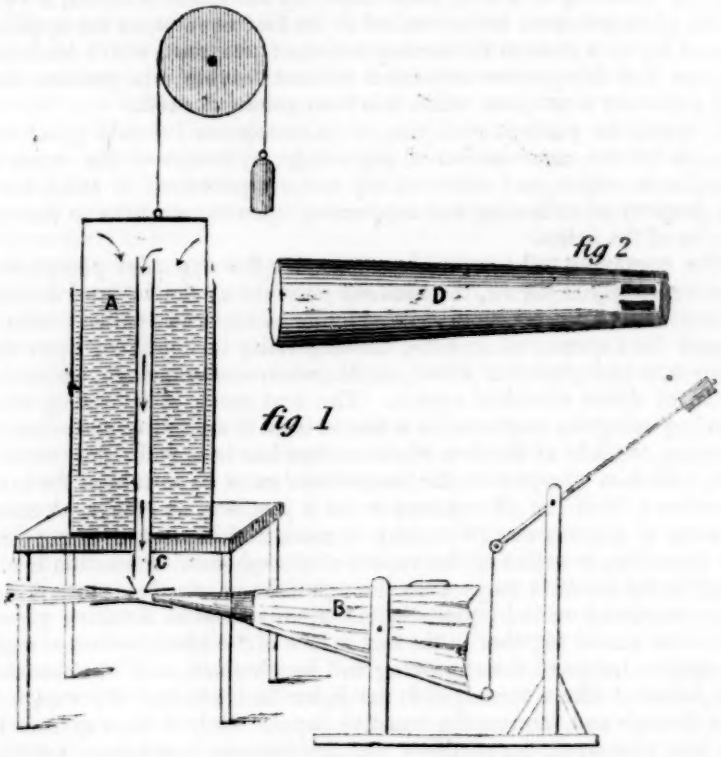


fig 1

fig 2

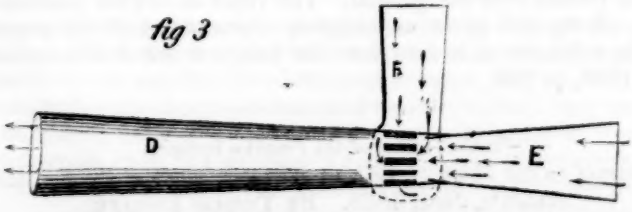


fig 3

Preliminary experiments established the fact that by reversing the position of the ordinary nozzle, and inserting the smaller end into the bel-

lows, it might be perforated through a part or the whole of its length, and so far from a particle of air rushing through it, escaping at the perforations, the external air would be drawn in through them, and augment the volume of the issuing blast.

A series of ten nozzles was at length prepared, their dimensions being limited by those of the experimental bellows. Made of tin plate, they were three inches long, and at one end all of the same bore, viz: $\frac{5}{16}$th of an inch. The other ends were gradually enlarged from No. 1, which was cylindrical, to No. 10, whose wide end was $\frac{1}{16}$. D, (fig. 2), represents one of them, having, like the rest, a row of elongated openings round the small end.

A conical tube, E, made to slip tight on the bellows pipe, was fitted and soldered to D, the small end terminating in the rear of the openings, as (fig. 3,) in section; the axis of both tubes coinciding, that the blast might not be directed more to one side of D than to another. The end of E enters into D.

A compound tube like this draws in air rapidly at the openings. To ascertain what proportion this air bears to that furnished by the bellows, and proximately to determine the proper angle of the diverging sides of the nozzle, was the object of the gas holder. Hence, the short pipe F, adapted to enter or receive the end of the pipe, C, of the gas holder, and made to enclose the openings as indicated by the dotted lines, was soldered and made air-tight at the junction of D and E. This was done with every nozzle.

Turn now to the apparatus, fig. 1, and the process of testing the value of each will be understood. When one (for example, fig. 3,) was connected to the gasometer and bellows, the end of D was closed by the palm of the hand, and the lever of the bellows allowed to descend. The contained air was consequently driven up into the gas holder, and its ascent marked by the scale, gave the quantity received. Then the hand was removed, and the lever permitted to descend as before, when the fall of the gas holder registered the amount withdrawn by the current passing through the nozzle.

Unnecessary to figure all the nozzles, it is sufficient to give the diameter of the wide ends, since in other points all were alike. The average results of several days' experiments, are given below. These were obtained from single strokes of the lever. When the bellows was connected directly to the gas holder, it rose nearly six inches. It never rose as high when charged through the perforations in the nozzles—through some not over four-and-a-half inches. Its passage was checked in the perforations, and the bellows being rather leaky, then leaked the more; hence, it would be giving a wrong result—one too favorable to the nozzles—to compare the quantity of air passed through each to the gas holder with that withdrawn by each.

The quantity of air drawn into the blast, it will be perceived, increased with the divergence of the sides up to No. 7, and then fell to No. 10. The discrepancy presented by No. 6 was doubtless due to defects of construction. The proper angle for the sides of a nozzle would seem, therefore, to be about that of No. 7; still the fact is not sufficiently settled. In another series of tubes were some that gave results approaching those

of No. 7, with less divergence. It is a question whether the proper divergence may not vary with the velocity of the blast. The joints of the nozzles with the gas holder and bellows were made tight with strips of india rubber.

Number of nozzles.	Bore of small ends.	Bore of large ends.	Fall of gas holder.	Per cent. of gain in the volume of the blast.
No.				
1	$\frac{5}{16}$ of an inch.	$\frac{5}{16}$ of an inch.	none.	none.
2	$\frac{5}{16}$ " "	$\frac{6}{16}$ " "	$\frac{1}{2}$ an inch.	8 +
3	$\frac{5}{16}$ " "	$\frac{7}{16}$ " "	1 inch.	16 +
4	$\frac{5}{16}$ " "	$\frac{8}{16}$ " "	$1\frac{1}{2}$ inches.	25
5	$\frac{5}{16}$ " "	$\frac{10}{16}$ — " "	$1\frac{5}{8}$ "	28 +
6	$\frac{5}{16}$ " "	$\frac{10}{16}$ + "	$1\frac{3}{4}$ "	25 —
7	$\frac{5}{16}$ " "	$\frac{12}{16}$ " "	2 "	33 +
8	$\frac{5}{16}$ " "	$\frac{14}{16}$ " "	$1\frac{1}{2}$ "	25
9	$\frac{5}{16}$ " "	$\frac{15}{16}$ " "	$1\frac{1}{4}$ "	20 —
10	$\frac{5}{16}$ " "	$\frac{17}{16}$ " "	1 "	16 +

It was of importance to know at what increased outlay of power, if any, this large addition of 30 per cent. and upwards to a blast is to be had. The limited dimensions and imperfections of the apparatus prevented a very accurate reply. From repeated observations, the time of the lever's descent when the communication of the nozzle with the gas holder was closed, was five seconds, and when open, five-and-a-half.

Of miscellaneous nozzles, some that were made of machine perforated plate, same as used in place of wire gauze for meat safes, were tried. The smaller end of one was seven-sixteenths of an inch, the larger eleven-sixteenths, and the length three-and-a-half inches. By one descent of the lever it lowered the gas holder nearly $1\frac{3}{4}$ inches; another, which flared $\frac{1}{16}$ more, brought it down to the same point.

The experiments were next varied by arranging the apparatus so as to insert the mouth of the nozzle, D, into the end of pipe, C, and thereby ascertain the effect of *forcing* air into the gas holder, instead of drawing it out. This would be determined by the difference between the rise of the gas holder when the tube, F, was left open, and when closed. The perforated plate nozzle last mentioned was first tried. One descent of the lever raised the gas holder $5\frac{1}{2}$ inches when F was closed, and $7\frac{1}{2}$ when F was open. The other tubes gave much the same result.

It must, however, be observed, that this increased effect ceased when the nozzle, D, was connected to C, at *right angles*, either by a tube of india rubber or tin plate. The change of direction and consequent resistance to the current was fatal to an increase of volume.

From this, the inference is, that the principle is hardly applicable to forge blasts or to vents buried in fuel. Be this as it may, there is no question about its application to the domestic bellows, for boards held

within an inch of the current issuing from the nozzles had no effect in diminishing the volume. Bellows made on this plan, would cost no more than the present one—little more than reversing the position of the nozzle is required. Hand bellows, used by silver-smiths, braziers, &c., are more commonly required to diffuse a blast than to concentrate it.

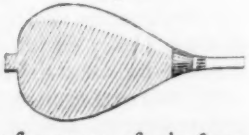
No additional gain was obtained by loading the bellows and making the blast stronger. From various trials the quantity of air drawn from the gas holder appeared to depend on that given out by the bellows, irrespective of velocity. It was remarkable how instantaneously the gasometer responded by falling at the least depression of the lever. The slightes tbreathing through the tube caused it to descend.

The results given are not the highest that were obtained. That 50 per cent., or even more, can be thus added to the blast, I have no doubt. Before the gas holder was fitted up, a glass receiver was suspended in water as one. By a small nozzle made for the mouth (the smaller end being a quarter of an inch bore), the receiver was charged by one full expiration from the lungs, and emptied by two-and-a-half directed through the open tube. This was repeated for several days, and was of itself conclusive.

It is a question whether, if the nozzles were flattened so that instead of a circle the section might resemble the openings in fig. 2, the effect might not be further increased.

Irrespective of bellows, this principle of increasing the volume of a blast without enlarging the capacity of the blower is certainly applicable to ventilation, evaporation of liquids, and other purposes in the arts—possibly to some musical wind instruments.

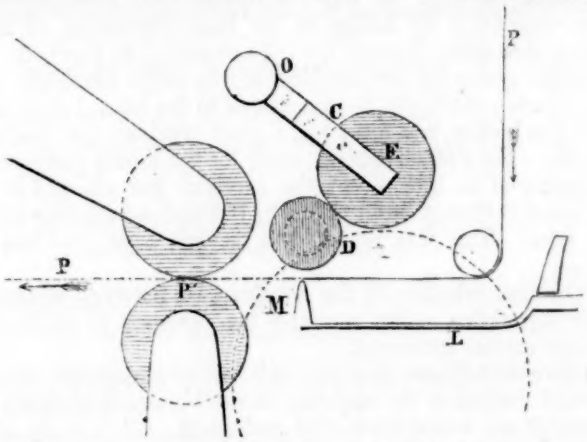
Fig. 4.



As every fact disclosed in physics illustrates, or is illustrated by, natural phenomena, the foregoing experiments may throw light on some atmospheric movements, such as the elevation of masses of air from the earth's surface by lateral gales in the upper regions; and possibly on whirlwinds, for every ascending column necessarily assumes a spiral movement. But passing these, do they not elucidate one of the smallest and commonest of pneumatic processes—that of breathing? How is it that men and animals do not repeatedly inhale the same breath? Laden with poison, air thrown from the lungs seems hardly to have time to get out of the way, so as to avoid being drawn back by the next inspiration. When a person is moving, or standing in a current, there is no difficulty; but during sleep in close rooms, and especially when a sleeper is motionless and respiration rapid, the danger would seem great—still it only appears so. Each respiration excites, as in these blowing tubes, a portion of the surrounding air to accompany it, and instantly to fall in behind, so as to intervene between the mouth and nostrils, and the impure volume ejected. It is as if the expired breath was received into a tube that closed itself when charged, and floated off. But for these ærial envelopes, breathing had been incompatible with health, since more or less expired air would be immediately reinspired—an evil as injurious as when two persons drink in each others' breath.

A New Telegraph.

The *Cosmos*, for March, describes a modification of the reading apparatus of Morse's telegraph, invented by MM. Digney and Baudouin, which is said to be successful in marking the Morse alphabet in ink upon the paper. The following cut illustrates the arrangement: D is a thin disk of metal, glass, or other sufficiently hard material, of from three-tenths to four-tenths of an inch in diameter. E, is the inking roller turn-



ing freely in its sheaf, which moves around a joint at O, pressing and rubbing gently on the disk D. By means of a screw, the roller may be displaced a short distance parallel to its axis, so as to bring a fresh circumference in contact with the disk. L M is the lever moved by the electro-magnet similar to those of the common Morse apparatus, but terminating in a hammer, or kind of knife, whose edge properly rounded raises the paper transversely, and presses it against D, at each vibration of the lever. This band of paper receives its movement from the rollers, P and P', as usual, and is moved in the opposite direction to the motion of the rollers, so that the impression made, is well defined. The ink is fat and fluid, dries slowly in the air, and remains a long time viscous.

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*On the Strength of Tone of Wires in Piano-Fortes.** By General T. Perronet Thompson, M. P.

The following observations on the strength of tone of wires, collected, with improvements, from a former work on the Theory of Music rather than on the Mechanics, may contain something useful to the constructors of musical instruments.

With the same materials and length, and when the difference of diameters is not very great, all wires break at the same pitch; which is the necessary result of the strength of the wire, and the load required to

* From the London Mechanics' Magazine, February, 1858.

bring it to the same pitch, both varying as the square of the diameter. If the wire of greatest diameter breaks sooner, it is because it is not treated with equal fairness at the bends; the remedy for which is to increase the diameter of the pin round which it is bent. If the wires were of very different diameters, the increased resistance of the air on the greater diameter would make the sound somewhat flatter, and consequently require an increased tension to overcome; which would be to the disadvantage of the thickest.

In wires of different diameter, but the same length and strained to the same pitch, the thickest will have the strongest tone; because the vibrating area, which is what strikes against the air, will be greater, being as the diameter.

In wires of different diameters and lengths, strained to the same pitch, the strength of tone will be as the diameter multiplied by the square of the length, or multiplied by the length twice over. For the diameter multiplied by the length expresses the vibrating area; and the extent to which the vibrations will be carried laterally, will be as the length again.

Follows, that when the same pitch is produced at different lengths of the same wire by different loads, the longest, and consequently the heaviest loaded, will have the strongest tone. Whence the strongest tones at all pitches, which can be obtained from any wire, are those produced by loading it to the extent of safety, and then taking the lengths which produce the pitches desired. And from the toughest materials may be had the longest wires and strongest tones. A way to judge of the toughness of steel wire without reference to its diameter, is to see how many yards of its own kind it will support. Good wire will bear the weight of 14,500 yards.

Follows from the same, that if wires of the same materials but different diameters, are loaded with equal weights, and the lengths taken which produce the same pitch, the longest and consequently the thinnest will have the strongest tone. For since the lengths will be inversely as the diameters, the vibrating areas will be the same in both; and consequently the longest, as making vibrations of greatest extent, will have the strongest tone. Whence it follows, that if the strain upon the frame is to be of a given amount and no more, the strongest tone with which the pitch in question can be produced with the given strain, is from the thinnest wire which will bear the strain, the length being at the same time increased as demanded. Which agrees with the last in showing, that all wires should be loaded to the extent of safety, if length can be afforded; or else tone is thrown away.

These conclusions bear on the construction of piano-fortes to the extent of showing that so far as other considerations do not interfere, the most advantageous shape and dimensions for what may be called the *harp*, are those indicated by loading a steel wire of the best quality and of any diameter, to the extent of safety, and taking on it the lengths required to make the different sounds, in other words, the lengths on the Monochord. This points to a wire of eight feet for bass C C, and sixteen feet for C C C. Now, wherever a grand piano-forte stands, there is a space of four feet for the performer; this, therefore, might be added

to the length of the longest wires, by placing them one over another in a narrow case next the wall, without virtually adding to the length required for the instrument. And such wires should be double.

The advantage of multiplying wires for the same sound, is that if a given quantity of strain instead of being applied to one wire which it loads to the extent of safety, is divided among four wires of the same length and half the diameter, the pitch and the sum of the strains will be the same as before, but the vibrating areas will be doubled, and consequently the strength of tone increased in something like the same proportion. And with any other number the advantage gained will be as the square root of the number of wires; which in round terms is with two wires, as 7 to 5, and with three, as $8\frac{3}{4}$ to 5. Hence the wires of the extreme bass ought to be doubled, as increasing the strength of tone in something like the proportion of 7 to 5, with the same total strain.

What is wanted, then, for improving the tone of piano-fortes, is, so far as other reasons do not intervene, to increase the length and thickness of the wires. And this will end in a contest for bearing the greatest strain; the tendency of which will be to make the frame approach to a solid shell of iron, being the form of the original lyre attributed to Mercury, which was the shell of a tortoise.

The same conclusions may be applied to strings of catgut, except that in consequence of the increasingly oblique action of the fibres in the thicker strings, the strain borne without breaking will not increase with equal regularity in relation to the diameter. But the string of catgut will bear to be strained to a higher pitch than a wire of the same diameter and length. For the loads required to bring these to the same pitch are as their specific gravities, which are as 1 to 6; while the loads they are able to bear are something like 1 to 3. Hence the wire to produce the final pitch of the catgut must be shortened to about five-sevenths (1 divided by the square root of 2), for no wire will bear straining to that pitch at a greater length; and to produce the final strength of tone of the catgut, the diameter of the wire must be doubled, with four times the strain which was on it before, making twelve times the strain finally on the catgut. Which explains the superiority of catgut for the instruments in which it is found employed.

Many of these conclusions may be what everybody is acquainted with, but some of them may be new to some.

Eliot Vale, Blackheath, Feb. 3, 1858.

Friction Rollers.

M. Alphonse Brussaut presented to the Society for the Encouragement of National Industry (Paris), a system of anti-friction bearings, in which the axle is supported upon rollers which are connected together by flexible bands of leather, canvass, or caoutchouc, in place of being rigidly confined in grooves as is usual. We do not anticipate from this system quite all the advantages which the Abbé Moigno attributes to it, viz: "the *complete abolition of friction*," *and a consequent* "*economy of two-thirds of the motive force employed*," (we translate literally,) the

avoidance of the necessity for greasing, "*which is so dirty and expensive,*" and the impossibility of wear of the bearings. Yet although probably we shall not reach such excellent results in this country, the system may be worth trying, and it certainly is not an expensive or difficult one. —*Cosmos*, vol. xii., p. 40.

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*On Color obtained from Coal Tar Products.** By Mr. Crace Calvert.

When, in November, 1854, I had the honor to read before this Society a paper on the products obtained from coal, I stated that ere long, besides carbo-azotic acid, some valuable dyeing substances would be prepared from this mineral. This expectation has been fulfilled. Messrs. W. Perkins and A. H. Church have obtained several blue coloring substances from the alkaloids of coal tar, and one from naphthaline, named by them Nitroso-phenyline and Nitroso-naphthyline, &c.

Mr. Perkins has lately taken a patent for the commercial application of some of these beautiful purple blue colors, which he has succeeded in fixing on silk, a sample of which I have the pleasure to lay before you. This fine color, which rivals the delicate and admired color of orchil, has this great advantage over it, that it is not destroyed by light; Mr. Perkins has, therefore, solved one of the problems of the art of dyeing, viz: the production of a fast color similar to the fugitive one of orchil. Mr. Perkins' process consists in dissolving in water the sulphates of aniline, of cuminine, and of toluidine, and adding a quantity of bicromate of potash sufficient to neutralize the sulphuric acid in these sulphates. The whole is left to stand for twelve hours, when a brown substance is precipitated, which is washed with coal tar naphtha, and then dissolved in methylated spirits. This solution, with the addition of a little tartaric oxalic acid, forms the dyeing liquor of Mr. Perkins.

Mr. Charles Lowe and myself have lately been fortunate enough to obtain from coal tar, products having a most extraordinary dyeing power, and yielding colors nearly as beautiful as safflower pinks and cochineal crimsons; and what increases the interest of this coal tar product is, that by the process we have discovered, we can obtain with it, on a piece of calico mordanted for madder colors, all the various colors and shades given by this valuable root—violet, purple, chocolate, pink, and red. The only thing which has prevented us from introducing into the market the crown red inodorous paper which we prepare, has been, that it is as yet too expensive to compete with this extraordinary color-giving root, but we intend pursuing our researches in the hope of employing it as a substitute for safflower or cochineal, two coloring matters, the price of which is sufficiently high to induce us to continue our investigations. We may add, that our imitation of safflower stands soap and light, whilst safflower colors do not.

I shall now draw the attention of the meeting to the preparation, dyeing, and printing of a magnificent crimson color, called murexide, obtained from guano, a substance which, until lately, has been entirely imported for agricultural purposes. The interesting application of this

* From the Journal of the Society of Arts, No. 274, 1858.

color to calico-printing has been, like many valuable chemical discoveries, progressive, and has only been brought to successful commercial application by successive discoveries, made by various persons.

Prout was the first chemist to remark that if the fæces of serpents were heated with nitric acid, and a little ammonia added, a beautiful purple color was produced. He named it purpurate of ammonia. This substance, when dry, has the appearance of a dark-red powder, soluble in water, to which it communicates a magnificent red color. This solution not only gives a precipitate with metallic salts, but when evaporated yields beautiful crystals, having the irridescent appearance of the wings of cantharides.

This discovery has also been useful to medical men, by enabling them to distinguish the uric acid calculi.

Messrs. Liebig and Wöhler had also investigated the subject, and succeeded in obtaining from the uric acid contained in the fæces of serpents this substance, which they called murexide, and a new class of organic substances, the knowledge of which has much facilitated the application of murexide to dyeing and printing. Mr. Saac was the first to apply the products of uric acid to the dyeing of fabrics; his process consisted in dipping woolen fabrics, prepared with a salt of tin, into a weak solution of alloxan, a product discovered by Liebig and Wöhler, in heating urea with nitric acid. The fabric so prepared was dried, and when submitted to heat a fine crimson was generated, the intensity of which was increased by the fumes of ammonia. But owing to the difficulty of obtaining a color of uniform shade, Mr. Saac's process required improvements, and these have been effected by Mr. Schlumberger.

The process followed by Messrs. Saac and Schlumberger, could not be applied to silk or cotton fabrics. The method of dyeing silk with murexide was discovered by M. de Pouilly, who adopted the following processes, viz: dipping the silk in a concentrated solution of bichloride of mercury mixed with murexide, squeezing the silk well and hanging it in the air, when a magnificent crimson insoluble compound is fixed on the silk. This effect is produced from the fact that when solutions of bichloride of mercury and murexide are mixed together, an insoluble compound is only formed after the lapse of an hour or two.

The process for dyeing cotton is due to Messrs. Lauth and Schlumberger, and consists in producing on cotton a purpurate of lead by mordanting with nitrate of lead, passing into an alkali, and then dyeing in a solution of murexide; in order to give full brilliancy to the color, it is lastly passed through a weak solution of bichloride of mercury. This process was further improved by Messrs. Dolfus, Meig & Co., in France, and Mr. Lightfoot, in Lancashire, by printing murexide with an excess of nitrate of lead, and subjecting the cloth so printed to the action of ammoniacal fumes, or passing it through a solution of caustic soda mixed with sal ammoniac. In order to render this substance more generally useful, it remained to find a method for obtaining fast colors with it on mixed fabrics, such as mousseline de laine, and this has also been effected by Mr. Schlumberger. The cloth is first prepared by uniting binoxide of tin with the wool. This object is attained by using a salt known to calico printers as pink salt, the double chloride of ammonium

and tin, and then printing on the prepared fabric the following mixture:—

1 part of murexide.
6 parts of nitrate of lead.
2 parts of nitrate of soda.

The pieces are then allowed to age for two or three days, when, to fix the purpurate of lead on the cotton, and the purpurate of ammonia on the wool, it is necessary to pass the cloth into a bath of bichloride of mercury, composed as follows:—

Water, ...	100 gallons.
Bichloride of Mercury, . .	6 pounds.
Acetate of Soda, . .	12 "
Acetic Acid, ...	2 quarts.

Until recently, all the green colors produced on fabrics were the results of blue and yellow mixed together; but of late public attention has been drawn to a green matter discovered by the Chinese, and fixed by them on cotton. It has been ascertained that they prepare it, by a long and tedious process, from two plants called Pa-bi-lo-za (*Rhamnus chlorophorus*), and Hom-bi-lo-za (*Rhamnus utilis*), and sell it in small square cakes, under the name of Luh-kaou or Luh-chao. The first commercial importation of this color, new to us, is quite recent, as the first public sale of it in England took place a week ago, at the quarterly indigo sales, under the name of China green indigo. No sooner had a foreign green substance been brought to our notice, than in Europe we had succeeded in obtaining also a green dyeing substance from the plants which surround us, and Mr. Schlumberger has been fortunate enough to fix on woollen fabrics the green chlorophylle, or coloring matter of leaves and grass. This discovery will, in time, prove of great service to dyers and calico printers. Mr. Schlumberger's process consists in boiling 60 lbs. of grass with 25 gallons of water. This operation is repeated, and the grass then treated with 25 gallons of soda lye, with addition of 2 to 4 lbs. of Mercer's dung substitute (phosphate of soda and lime). Boil half-an-hour, and then add excess of hydrochloric acid; a green precipitate falls, which is separated by filtration. The precipitate is dissolved in very dilute soda lye, adding a little of the substitute, and the silk or wool to be dyed is dipped in until the desired shade is obtained. Stannate of Soda is the only mordant which gives any beneficial results.

M. Pelouze has rendered lately a great service to Turkey red dyers, by enabling them to use any oil, instead of only Gallipoli oil, and this of special quality. M. Pelouze has discovered that the difference there was betwixt a Gallipoli oil, which could be employed with advantage to produce a Turkey red on cotton, and one which could not, was, that the first contained a large proportion of free fatty acid, whilst the latter was nearly neutral. This led M. Pelouze first to prepare, artificially, oils of good quality for Turkey red by mixing oleic acids with neutral oils; and, secondly, to the interesting scientific observation that oils were susceptible of undergoing a spontaneous fermentation as well as saccha-

rine juices, or other organic fluids. Thus, immediately the neutral fatty matters in the cells of fruits or roots are brought in contact with the ferment which all vegetable substances contain, by breaking the cells in which the fatty matters are deposited, the oil enters into fermentation, and the fatty acids are liberated from the glycerine with which they had been combined. This discovery gives us an insight into the acidity of some oils and the rancidness of others.

For the Journal of the Franklin Institute.

Propellers for Cuba.

Messrs. Merrick & Sons have recently finished for Don Pedro Lacoste, of Havana, two steamers built expressly to carry freight and passengers between Cardenas and Havana. Their names are *Cardenas* and *Alfonso*, and their principal dimensions are as follows, viz:

Length on deck, ...	180 feet.
Beam, ...	30 "
Hold, ...	11 "

Schooner rigged with three masts.

Each vessel has 2 vertical cross-head condensing engines placed across the vessel, and driving the propeller shaft by gearing $2\frac{2}{3}$ to 1. Diameter of cylinders, 40 inches; stroke, 3 feet; average revolutions of engines, 32; diameter of propeller, 8 feet 6 inches; length on shaft, 2 feet; 4 blades. Average pressure of steam, 25 inches; throttle open and cutting off at 13 inches from commencement of stroke; vacuum, 26 inches. Taking the distance from the Navy Yard Shears to Fort Mifflin as $8\frac{1}{4}$ miles, *which it is usually called on trial trips*, their average speed with and against the tide, light, was 13·43 miles per hour; and loaded with 340 tons of coal on board, 13 miles per hour—but as the real distance is but 7·13 instead of $8\frac{1}{4}$ miles, so the real speed, light, was 11·60 miles, and loaded 11·24 miles. The hulls of these vessels were modeled and built by the Messrs. Cramp, of Kensington, and for beauty of form and excellence of workmanship, would be difficult to surpass. A.

Electro-motive Forces of various Batteries.

M. Petruscheski, a Russian experimenter, gives the following as the results of his investigations on the power of different voltaic combinations:—

Grove, with amalgamated zinc, . .	1·78
Battery of cast iron and amalgamated zinc, .	1·72
Bunsen, ...	1·69
Eisenlohr (Daniell's, with tartrate of potassa in place of sulphuric acid), . .	1·05
Daniell, with chloride of sodium, . .	1·05
" chloride of sodium and amalgamated zinc,	1·01
" with dilute sulphuric acid, .	1·00
Eisenlohr, with zinc not amalgamated, .	0·99
Daniell, dilute sulphuric acid and amalgamated zinc,	0·93
Wallaston, with amalgamated zinc, .	0·93

Cosmos, vol. xii., p. 4.

LAW REPORTS OF PATENT CASES.

Decision of the Supreme Court in the Reaping Machine Case.

This case was argued by Reverdy Johnson and E. N. Dickerson for Complainant, and George Harding and Edwin M. Stanton for Defendants. The suit involved a large amount of money and several important principles of interpretation of patents. The Court affirmed Judge McLean's opinion, which was published on page 176, of vol. xxxi., *Journal of the Franklin Institute.*

CYRUS H. MCCORMICK, *Appellant*, vs. WAIT TALCOTT, RALPH EMERSON, Jr., JESSE BLINN, and SYLVESTER TALCOTT, survivors of JOHN H. MANNY.

Appeal from the Circuit Court of the United States for the Northern District of Illinois.

Mr. JUSTICE GRIER delivered the opinion of the Court.

The bill charges the defendants with infringing two several patents granted to complainant, for improvements in the machine known as McCormick's Reaper. One of these patents bears date the 31st of Jan., 1845; the other on the 24th of May, 1853, being the re-issue of a previous one, dated 23d of October, 1847. The defendants are charged with infringing the fourth and fifth claims of the patent of 1845 and the second claim of the re-issued patent of 1853.

I. The first infringement charged is that of the divider, or that part of the reaping machine which is defined "as an arrangement, or apparatus, for separating the grain to be cut from that which is to be left standing."

The claim is as follows: "4th, I claim the combination of the bow L and the dividing iron M, for separating the wheat in the way described."

The description referred to is as follows:

"The *divider* K is an extension of the frame on the left side of the platform, say three feet before the blade, for the purpose and so constructed as to effect a separation of the wheat to be cut from that to be left standing, and that whether tangled or not. E is a piece of scantling, say three feet long and three inches square, made fast to a projection of the platform by two screw bolts. To the point of this piece, at K, is made fast by a screw or *bolt* a bow L of tough wood, the other end of which is made fast in the hinder part of the platform at R, and it is so bent as to be about two and a half feet high at the (left) reel-post, and about nine inches *out* from it, with a regular curve. The *dividing-iron* M is an iron rod of a peculiar shape made fast to the point of the same piece E, and by the same screw-bolt that holds the bow L. From this bolt this iron rises towards the *reel* S, at an angle of say 30°, until it reaches it, then it is bent so as to pass under the reel as far back as the blade, and to fit the curve of it (the reel). From the bolt in the point aforesaid, the other end of this iron extends, say nine inches, along the inside of the piece E, where it is held by another screw-bolt M, and where it has a groove (or slot) in it to admit the other ends being raised or lowered (turning on the point screw K as a pivot) to suit the height of the reel. By means of the bow to bear off the standing wheat, and the iron to throw the wheat to be cut within the powers of the reel, the required separation is made complete."

The answer denies that the arrangement of the divider used by defendants for separating the grain to be cut from that to be left standing is the same in construction or mode of operation as that claimed by complainant, or a colorable evasion of said claim, and avers that it is a different and distinct arrangement invented by J. H. Manny after several years' experiments.

It would be a difficult task to make intelligible to the uninitiated the construction of a very complex machine without the aid of models or diagrams. But, for the purpose of the case, the divider, although a component part of the great complex machine called the reaper, may be considered by itself as a machine, or combination of devices, attached to the reaper to perform certain functions necessary to complete the whole operation. In order to ascertain whether the divider used by defendants infringes that of the complainant, we must first inquire whether McCormick was the first to invent the machine called a divider, to perform the functions required, or has merely improved a known machine by some peculiar combination of mechanical devices which perform the same functions in a better manner.

If he be the original inventor of the device or machine called the divider, he will have a right to treat as infringers all who make dividers operating on the same principle, and performing the same functions by analogous means or equivalent combinations, even though the infringing machine may be an improvement of the original, and patentable as such. But if the invention claimed be itself but an improvement on a known machine by a mere change of form or combination of parts, the patentee cannot treat another as an infringer who has improved the original machine by the use of a different form or combination performing the same functions. The inventor of the first improvement cannot invoke the doctrine of equivalents to suppress all other improvements which are not mere colorable evasions of the first.

That portion of a reaping machine called the divider or separator may be described as a pointed, wedge-formed instrument, which is attached by its butt to the platform at that extremity of the cutting apparatus which runs in the grain, in such manner that its point projects in advance of the cutting apparatus, and enters the standing grain. Its functions, where the grain stands erect, are to divide it into two portions, one of which is borne inwards by the inner side of the wedge-formed implement within the range of the cutting apparatus and of the reel, in case the machine is fitted with a reel; the other portion of the grain is borne outwards by the outer side of the divider, so as to be passed by that portion of the machine which lies behind the cutting apparatus. When grain is inclined outwards, the function of the divider is not only merely to divide the grain into portions, but also to raise up the inclined stalks of the grain, below which the divider passes. When the grain inclines inwards, the function of the divider is not only to divide the mass, but also to raise up the inclined stalks of grain beneath which the divider passes, and to bear them outwards without the range of the reel, if the machine has a reel, and of the cutting apparatus. When grain, in addition to being inclined, is also entangled, the divider not only separates and raises the stalks, but also

tends to disentangle them. The lower face of a divider also performs the function of a shoe or runner, to prevent the cutting apparatus from digging into the earth, when, by any accidental movement of the machine, it would otherwise do so. The divider also performs the function of limiting or regulating the width of the swath, by raising up and turning inwards those stalks of grain which, from their inclination outwards, would otherwise escape the action of the cutter; and by raising up and turning outwards those stalks of grain which, from their inclination inwards, would otherwise be within the range of the cutter. All dividers perform these functions in a greater or less degree. The English patent of Dobbs, in 1814, had dividers of wood or metal. The outer diverging-rod rose as it extended back, and diverged laterally from the point to raise the stalks of grain inclining inwards, and to turn them off from the other parts of the machine. The patent of Charles Phillips of 1841, had a divider, shaped like a wedge, performing the same function, turning the grain aside on both sides of the machine and raising it up. Ambler's machine had a triangular divider performing the same functions, as also the machines of Hussey, Schnebly, and that of McCormick, patented in 1834, and which is now public property. The present claim is for the combination of the outside bow, with a dividing iron of a certain form, and for nothing more. This dividing iron is but a new form or substitute for that side of the triangle or wedge which in other machines performed the function of separating the inside grain and raising it to the cutters.

It is described in the patent as having these peculiarities to distinguish it from those that preceded it.

1. It rises at an angle of about 30 degrees till it reaches the reel.
2. It is curved under the reel.
3. It is made adjustable by means of a slot, so as to suit the different heights of the reel.

Its function is to raise and support the grain along the inner edge of the divider, at the maximum elevation consistent with the employment of the reel. As a form or combination of devices it is new, and no doubt an improvement, and therefore the proper subject of a patent. But as a claim for a combination of mechanical devices or parts, it is not infringed by one who uses a part of the combination. Nor can it challenge other improvements of the same machine, different in form or combinntion, as infringements, because they perform the same functions as well or better by calling them equivalents. The machine constructed under defendants' patent has a wooden projection, somewhat in the form of a wedge, extended beyond the cutting-sickles some three feet, and which, from the point in front, rises as it approaches the cutting apparatus, with a small curve (not approaching to an angle of thirty degrees) so as to raise the leaning grain. It has no dividing iron, nor substitute or equivalent possessing the peculiar qualities of that instrument. It more resembles the wedges in use before McCormick's patent of 1845. As an improvement on former machines, it has some peculiarities of form and construction, but it does not adopt the combination of complainant's patent. It is a distinct improvement, probably inferior to McCormick's, but certainly no infringement of his claim.

II. The fifth claim of complainant's patent of 1845, which the bill charges the defendants with infringing, is as follows:

"5th. I claim setting the lower end of the reel post R behind the blade, curving it at R^2, and leaning it forward at top, thereby favoring the cutting, and enabling me to brace it at top by the front brace s, as described, which I claim in combination with the post."

In the reaping machine of McCormick's original patent of 1834, he had placed the reel-post in front of the cutters. This position of the post interfered with the action of the reel in drawing the grain to the cutters, especially in gathering tangled grain. In order to remedy this defect of his own machine, he set the post farther back, and braced it as described.

Defendants do not support their reel by posts, as was done by McCormick. They use the horizontal reel-bearer connected by a frame with the hinder part of the machine. This device for supporting the reel was invented and used many years before McCormick's first patent of 1834. It had no reel-post situated as in his patent, and encountered none of the evils remedied by the change in its position. This attempt to treat the earlier and better device used by defendants as an infringement of a later device to obviate a difficulty unknown to the first, is an application of the doctrine of equivalents which needs no further comment.

III. The bill charges defendants with infringing the second claim of the re-issued patent of 1853. This claim is as follows:

2. "And I also claim the combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the seat or position for the raker *arranged and located as described*, or the equivalent thereof, to enable the raker to rake the grain from the platform, and deliver and lay it on the ground at the side of the machine as described."

If this claim be construed to include all machines which have a reel and a raker's seat, it is void, for want of novelty. Hite, Woodward, Randall, and Schnebly, had invented and publicly used reaping machines which had reels, and a place for the raker on the machine. But the true construction of this claim, and the only one which will support its validity, is to treat it as a claim for a combination of the reel with a seat "arranged and located as described." And such was the construction given to it by the complainant himself when the Commissioner had refused to grant him a patent claiming the mere combination of a reel and a raker's seat, "because such a combination was not patentable, the functions of each device having no necessary connexion with the other."

This arrangement for the location of a raker's seat was made "by placing the gearing and crank forward of the driving-wheel, and thus carrying the driving-wheel further back than heretofore, and sufficiently so to balance the rear part of the frame and the raker thereon."

By this device he obtained a place for the raker over the finger-bar, just back of the driving-wheel, and at the end of the reel, where he could have free access to the grain, and rake it off the machine at right angles to the swath. It was by limiting his claim to this arrangement,

location, and combination, that the complainant obtained his patent; and without this construction of it, the claim is neither patentable nor original.

The arrangement, combination, and location of the raker's seat used by defendants, has been patented to Manny, as an independent contrivance, and distinct invention. The place for the raker is obtained by a change in the shape of the platform, different from any before employed. It differs from the complainant's device in principle as well as in form and combination. The raker's seat is on a different part of the machine, where he may stand without destroying the balance of the machine, or tilting it up. It requires no modification of the reel. It requires no such combination or modification of parts of the machine in order to find a place for the raker, which is an essential part of complainant's claim.

It is substantially different, both in form and in combination, from that claimed by the complainant, and is consequently no infringement of his patent.

Concurring, as we do, in the opinion and decision of the Court below on these several points, the decree is affirmed with costs.

Improvement in Paper Making.

The softening properties of glycerine, now so beneficially used in surgery and for other purposes, is about to be introduced in the making of paper. From experiments made, it is concluded that it will render the surface of paper so absorbing that it will allow of its being printed dry. If this desideratum is achieved, the fine surfaces of the paper now obtained in its make will not be removed by damping, as is the case now in letter-press and copper-plate printing.—*Civ. Eng. and Arch. Journal, Jan.* 1858.

For the Journal of the Franklin Institute.

Steam War Sloops.

At the last Session of Congress, the Secretary of the Navy was authorized to construct five steam propeller sloops of war. It has been decided to build them at the following places: Boston, New York, Philadelphia, Norfolk, and Pensacola. The New York vessel is building by contract, both as to hull and machinery—the former is building by Jacob Westervelt, and the latter by James Murphy & Co. All the other hulls are building at the different Navy Yards. The machinery for the Boston vessel is building by Loring & Coney, and for the Philadelphia vessel by Reany, Neafie & Co. For the Norfolk sloop, and also the one at Pensacola, it is understood the engines are to be built at the Washington and Norfolk Navy Yards. X.

For the Journal of the Franklin Institute.

Particulars of the Steamship Phineas Sprague.

Hull built by Birely & Lynn, Philadelphia. Machinery by Merrick & Sons, Philadelphia. Service, Boston to Philadelphia.

HULL.—

Length (for tonnage),	195 feet.	3 inches.
Breadth of beam (molded),	30 "	5 "
Depth of hold, to spar deck,	18 "	
" lower deck,	10 "	9 "
Length of engine space,	41 "	
Draft at usual load,	15 "	
Tonnage, custom-house,	894.	
Contents of bunkers in tons,	75.	

Masts—three.—Rig—foremast square rigged.

ENGINE.—One—Inverted Vertical, Direct acting.

Diameter of cylinder,		50 inches.
Length of stroke,	3 feet	8 "
Cut-off, (from commencement of stroke),		24 "
Average revolutions per minute,	48 to 50.	

BOILER—One—Rising flue.

Length of boiler,		19 feet.	
Breadth "	at furnace,	14 "	6 inches.
	round shell,	12 "	6 "
Height "	exclusive of steam drum,	12 "	6 "
" "	inclusive "	21 "	6 "
Number of furnaces,	3.		
Breadth "		4 "	2 "
Grate surface,	81 sq. feet.		
Length of grate bars,		6 "	6 "
Number and diameter of flues,	below: 2 of 23 in., 2 " 22 ", 2 " 18 ", 4 " 17 ", 2 " 10 "	above: 24 of 11 inch., 4 " 10 "	
Length of flues,	below,	7 "	6 "
	above,	13 "	2 "
Heating surface,	2200 sq. ft.		
Diameter of smoke pipe,		4 "	6 "
Height "	above top of drum,	35 "	
Consumption of coal per hour,	1600 pounds.		
Pressure per square inch in pounds,	22.		

PROPELLER.—

Diameter of screw,	12 feet.		
Length "	2 "	6 inches.	true screw.
Pitch "	25 "		
Number of blades,	4.		
Speed in knots during trip,	average 10½.		

Remarks.—Thrust of screw taken on Parry's patent conical rollers. Hull strapped internally with double-laid diagonal bars, $4\frac{1}{2} \times \frac{5}{8}$-inch. Has independent steam pump, and auxiliary boiler.

The above data of coal, speed, steam pressure, revolutions, &c., are the average of her performance at sea in all weathers, since September, 1857, when she commenced her trips. J. V. M.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 15, 1858.

John Agnew, Vice-President, in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Society of Arts, &c., London, and from Sydney S. Lyons, Esq., Jefferson, Indiana.

Donations to the Library were received from the Society of Arts, Manufactures, and Commerce, and from the Rev. R. Everest, London; The Hon. David Dale Owen, Jefferson, Indiana; The Light-House Board, Treasury Department, Washington City, D. C.; The Ohio Mechanics' Institute, Cincinnati, Ohio; The Board of Water Commissioners, Detroit, Michigan; The Legislature of the State of Pennsylvania, Harrisburgh, Pa.; and from Prof. B. Howard Rand, Dr. Gouverneur Emerson, Prof. John F. Frazer, and the Schuylkill Navigation Co., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of March.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (2) were proposed, and the candidates (2) proposed at the last meeting were duly elected.

Mr. Howson exhibited a model of an apparatus for clearing the coulters of ploughs, invented by Mr. Abner Reeder, of Bucks Co., Penna. It consists of a spring sliding rod guided in brackets, one attached to the handle and the other to the beam of the plough, the end of the rod being furnished with three prongs, so arranged and situated that on forcing down the rod they will pass at an angle with and in front of the coulter and beneath the beam.

The instrument is entirely within the control of the ploughman, who is thus enabled to clear away the soil which is apt to accumulate in front of the coulter, and retard the progress and effectual action of the plough.

This device is of much importance, as by its adoption the extra assistant frequently employed to effect the purpose it accomplishes so well may be dispensed with.

Mr. Albert Williams exhibited an improved compound gauge, combining the mortise gauge, single point gauge, cutting gauge, and marking gauge for metal workers and machinists. The stem of this gauge is made of metal, and is 6½ inches long and ⅜-inch thick; the head is made of rosewood, double-faced one side to be used by carpenters and other workers in wood; the other with steel, for the use of metal workers and machinists. The mortise point works with an anti-friction screw and cylinder at the end of the stem.

Mr. G. B. Turner, of Cuyahoga Falls, Summit Co., Ohio, exhibited a model of his improved combined smutter and grain separator. In the machine the smutter is composed of from three to five setts of horizontal scouring plate, between which the grain passes. The lower plate or runner of each sett is provided with beaters, which throw the grain against

the upper plate, which is stationary, and also provided with beaters, thereby causing the grain to act against both plates with equal certainty and uniformity. A rough or sharp surface is not depended upon for scouring, but it is claimed that what the machine will do the first month it will continue to do for years, in the same manner.

The machine is well ventilated, by a blast from the lower fan into the centre of the machine, by which there is no possibility of its ever becoming filled up or clogged with dust.

It makes *five* distinct separations:—1st, The heads, sticks, &c., over the riddle. 2d, Screenings from the first blast, (which are the lightest,) and before the grain enters the smutter. 3d, The dust. 4th, Screenings from the second blast of the separator, after the smutter. These last are free from dust, and in good condition to grind for feed or otherwise. 5th, The clean grain, at the bottom of the machine.

Only one driving belt is required, and but two in all—and can be as easily attached as any upright smutter. Rolling screens may be dispensed with, except for cockle.

Mr. J. D. Rice exhibited Gatchel's improved copper braid lightning rods, and stated that this improvement in conductors consists in forming from *copper wire*, a braid or cord of one continuous length to any extent required. Its superiority over the iron rods in common use, briefly stated, are: first, the *greater conducting power* of copper—being 6 to 8 times that of iron; second, its *durability*, not rusting like iron, consequently not staining walls of buildings, &c.; third, its *flexibility* makes it particularly applicable to *vessels' masts*, &c., as well as buildings; fourth, its *cost* being very moderate, makes it the most *economical* rod used—for ordinary buildings costing from $20 to $30, or in other words, it will be applied to buildings at 30 cents per foot.

Mr. W. Jones exhibited a model of a marine governor, invented by Mr. W. H. Brown, of this City. This governor resembles that ordinarily employed on stationary engines. Its mode of operation, however, is different in this respect—that the balls diverge in a line at right angles to the spindle, in consequence of which arrangement, the force of gravity has no effect to cause the balls either to diverge or to approach each other.

The bars to which the balls are attached are each connected by a joint to a sleeve which slides upon the spindle. This sleeve is provided with collars, by which it is connected with the throttle-valve of the engine in the usual manner. To each bar at a point equidistant from the centre of the ball, and from the movable sleeve, a link is attached, the length of which is equal to one-half the distance between the sleeve and the centre of the ball. These links connect the bars with another sleeve, which is firmly fixed on the spindle opposite the balls. Between the two sleeves, a spiral spring encircles the spindle; and by the pressure of this spring upon the movable sleeve, the balls, when the governor is not in motion, are drawn inward, so as to rest against the stationary sleeve. When the governor revolves, the balls diverge at right angles to the spindle, and by their divergence, the movable sleeve is drawn toward the stationary one, the spiral spring being at the same time compressed. As, by a diminution of velocity, the balls lose their centrifugal force, the expansion of the spring causes them to approach each other.

Abstract of Meteorological Observations for February, 1858; made in Philadelphia, Northampton, Somerset, Bedford, and Huntingdon Counties, Pennsylvania, for the Committee on Meteorology of the Franklin Institute.

February, 1858.	PHILADELPHIA.—Lat. 39° 57′ 28″ N. Long. 75° 10′ 28″ W. Height above the sea 50 feet. Prof. J. A. KIRKPATRICK, Observer.									EASTON, Northampton Co.—Lat. 40° 43′ N. Lon. 75° 16′ W. Height above the sea about 340 feet. SELDEN J. COFFIN, Observer.						SOMERSET, Somerset Co.—Lat. 40° N., Lon. 79° 3′ W. GEO. MOWRY, Observer.				BEDFORD, Bedford Co. SAMUEL BROWN, Observer.			HUNTINGDON, Huntingdon County. JACOB MILLER, Obser.		
	Barometer.		Thermometer.			Relative humidity.	Force of vapor.	Rain and Snow.	Prevail'g winds.	Bar.	Ther.	Relative humidity.	Force of vapor.	Rain and Snow.	Prevail'g winds.	Bar.	Ther.	Rain and Snow.	Prevail'g winds.	Bar.	Ther.	Prevail'g winds.	Ther.	Rain and Snow.	Prevail'g winds.
	Mean.	Mean daily range.	Mean.	Daily oscillation	Mean daily range.	2 P. M.	2 P. M.			Mean.	Mean.	2 P.M.	2 P.M.			Mean.	Mean.			Mean.	Mean.		Mean.		
	Inch.	Inch.	°	°	°	Per.ct.	Inch.	Inches.		Inch.	°	p. c.	Inch.	Inch.		Inch.	°	Inch.		Inch.	°		°	Inch.	
1	29·920	·181	31·7	19	2 5	62	·126	1·026	E N E.	29·577	23·8	72	·114	0·58	(var.)	27·467	24·3	0·223	S.	28·966	27·3	S E.	28·5	Snow.	E.
2	29·507	·413	41·7	11	10·0	83	·221		S W.	29·070	35·7	83	·185		W.	27·271	30·0		W.	28·684	33·7	(var.)	36·0		W.
3	29·906	·399	41·0	9	3·3	40	·124		W.	29·477	34·7	50	·110		W.	27·689	27·7		W.	29·104	33·0	N W.	31·0		W.
4	29·894	·087	38 5	6	3·5	64	·159		WSW.	29·533	33·7	50	·113		N W.	27·642	26·0		(var.)	29·039	33·7	N W.	27·5		N.
5	29·825	·075	32·2	10	6·3	50	·103		(var.)	29·473	24·7	54	·087		N W.	27·606	20 7		N W.	29·017	22·0	N W.	23·5		N.
6	30·037	·212	39·3	15	2·8	50	·097		N W.	29·657	23·3	44	·070		(var.)	27·705	22·7		WSW.	29·165	27·3	S W.	30·0		W.
7	29·874	·162	38·8	18	8·5	54	·164		S W.	29·520	33·9	64	·162	0·01	(var.)	27·632	29·3		W.				34·0		(var.)
8	29·981	·107	35 8	10	3 0	47	·117		(var.)	29·630	29·3	44	·089		N W.	27·733	27·3		W.	29·152	30·7	N W.	30·0		N W.
9	29·693	·288	41·0	11	5·8	44	·152		(var.)	29·317	36·7	47	·134		S W.	27·309	32·7	0·505	S W.	28·800	30·3	N W.	30·5	Snow.	N W.
10	29 515	·355	38·0	23	11·0	26	·075		W.	29·090	29 4	27	·055		W.	27·352	18·7		W.	28·744	21·7	N W.	15·0		W.
11	30·009	·494	20·2	13	17·8	37	·050		W.	29·610	11·7	25	·022		W.	27·675	7·7		W.	29·145	11·3	N W	14·0		W.
12	30·082	·106	24·5	12	4·3	54	·083		S E.	29·700	17·8	38	·048		(var.)	27·676	19·7		S.	29·151	23·3	N W.	23 0		N W.
13	29·960	·122	23 0	8	4·2	62	·083		N E.	29·627	16·0	53	·055		N E.	27·547	16·7	0·328	S E.	29·058	22·3	S E.	21·0	Snow.	E.
14	29·851	·110	24·2	8	2·2	81	·115	0·095	N E.	29·477		75	·068	0·11	(var.)	27·525	26·3		W.				25·0		(var.)
15	30·008	·157	28·5	14	4·3	60	·113	0·005	S W.	29·593	21·5	41	·057		N W.	27·775	21·0		W.	29·178	26·3	N W.	23·0		N W.
16	29·936	·194	28·7	15	1·8	61	·129		W.	29·527		71	·108	0·01	(var.)	27·689	22·3	0·146	W.	29·096	25·7	N W.	18·5		W.
17	30 010	·107	17·2	18	11·5	45	·053		N W.	29·640	10·2	50	·047		N W.	27·770	9·3		N W.	29·230	7·3	N W.	14·0		N.
18	30·026	·016	22·7	17	5·5	43	·066		N W.	29·647	15·3	58	·057		N W.	27·679	19·7	0·256	(var.)	29·131	23·3	N W.	22·0	Snow.	N.
19	29·910	·116	17·7	13	8 3	83	·074	0·214	N E.	29·600	10·0	100	·067	} 0·34	(var.)	27·481	18·7	0·248	S.	28·978	22·3	S E.	19·5	Snow.	E.
20	29·634	·276	26 5	12	8 8	77	·124	0·973	(var.)	29·263	22·3	76	·122		(var.)	27·456	15·7	0·253	W.	28·878	20·0	N W.	22·5	Snow.	N.
21	29·746	·112	27·5	18	3·7	70	·129	0·080	N W.	29·357	23·2	59	·093		W.	28·460	27·0	0·087	WSW.				28·5		W.
22	29·892	·147	26·7	9	5·5	46	·077		NNW.	29·547	20·2	42	·057		N W.	27·643	16·0		N.	29·090	18·7	N W.	19·5		N.
23	30·163	·270	21·7	16	5·0	32	·049		N W.	29·800	13·3	35	·041		N W.	27·837	13 3		N W.	29·307	16·7	N W.	12.0		N W.
24	30·077	·167	22·8	19	2·5	46	·077		NNW.	29·707	13·0	45	·058		S E.	27·691	20·3		S.	29·155	18·0	S W.	16 0		(var.)
25	29·761	·316	30·0	26	7 2	40	·104		(var.)	29·363	24·5	60	·115		W.	27·501	29 3		S W.	28·915	28·7	S W.	30·5		(var.)
26	29·819	·074	23·2	13	5·8	45	·103		N W.			51	·101		(var.)	27 579	26·7		W.	28·973	25·7	N W.	25·0		N W.
27	29·824	·047	35·0	22	6·2	50	·149		S W.							27·486	37·3		(var.)	28 891	35·0	S W.	37·5		S.
28	29·603	·218	44·0	19	9 0	52	·196		S W.	29·213	36·8	52	·156		(var.)	27·310	40·3	0·172	S W.				41·0	0·082	S.
Means	29·874	·190	30·1	14	6·1	54	·111	2·393	n65°w.	29·498	23 4	54	·089	1·05		27·579	23·0	2·218					25·0	0 082	